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Electric welding machine ratings

It is a common practice to rate electric welding generators in amperes, assuming a fixed voltage drop across the arc of 25 volts. Up to the present time at least, this simple method has been generally satisfactory. New kinds of welding electrodes now coming into use may require a re-rating or a different method of rating the machines. When a bare metallic electrode is used, the voltage across the arc is usually about 20 volts, but the use of some of the newer coated electrodes may cause this voltage to rise to 35 volts. The power output of any electric generator is not measured in amperes but is a product of the flow of current through the arc, times the voltage across the terminals of the machine. A welding generator can be overloaded without exceeding its rated capacity in amperes, with possibly damage to either the generator or the driving motor. Such overloading may be of particular importance in the case of welding generators driven by gasoline engines; while overloading probably will not injure the engine, the generator may fail to function properly because of insufficient power. Checking these conditions will prevent damage to machinery and may serve to improve the quality of welds.

New metal for cutting tools

Machine tool users and builders are both interested in the development of high-speed cutting tools. The invention of high-speed tool steel, approximately fifty years ago, not only made it possible to increase enormously the rates of metal cutting, but spelled the doom of old machine tools. Faster and heavier cuts required a more rigid construction of machine tools which gradually led to a complete change in their design. Although the present day machine tool is a giant in comparison with its predecessors, the end of its development as a production unit is not yet in sight.

With the recent introduction of new cutting tool materials, made up of tungsten-carbide embedded in a matrix of cobalt, still greater strength and more power will be required of machine tools if all advantage is to be taken of the new cutting materials. As a matter of record, the Schiess-Defries Machine Tool Company of Dusseldorf, Germany, has already built a number of machines especially designed for the use of the new cutting metal, and the results obtained appear to be little short of startling. For example, on work 2¼ in. in diameter, a cutting speed of 330 ft. per min. has been achieved, corresponding to a rotary speed of 560 r.p.m.

Higher speed cutting tools can be put to good use in the railroad shop. It is doubtful whether full advantage can be taken of the new cutting materials if used on the machine tools common to the railroad shop. Thus, the mechanical department officers will soon be confronted with the problem of deciding whether to continue to use the present machine tool equipment or purchase machine tools on which the new cutting tool metal can be used. The railroads follow one of two policies in the purchase and utilization of machine tools. One policy is to conserve the initial investment as much as possible, and to use the machine tool as long as it turns out work. The other is to get out of the tool all that it can do in the shortest possible time and then replace it by a new tool. The railroads turn toward the first policy for the reason that they are not primarily engaged in competitive production. The development of the new cutting metal may, however, introduce an important new factor in that in addition to what may be called natural obsolescence, the machine tool may become obsolete overnight through the fact that suddenly it becomes unable to compete with newer tools, especially designed for the use of the new high-speed cutting alloys.

As was the case with the special cutting steels, the future of the utilization of the new cutting materials is in the hands of the machine tool builders. The discharge of this responsibility will be of advantage to machine-tool users and builders alike, because if the new metals fulfill the expectations which they raise, the improved productivity of the tools and the lower cost of operation brought about, will rapidly pay for the residual value of the prematurely discarded tools, and will in addition, greatly speed up production.

Do your men visit other shops?

Any one who has been privileged to visit many of railroad shops cannot fail to be impressed by the wide diversity of methods used to accomplish the same kind of work. One may visit a shop and there see a device developed by a workman in that shop to assist in the fabrication or assembly of some part used on a locomotive or car. As it relates to that one particular shop's problem in accomplishing a specific piece of work, there is no doubt that, by comparison with the manner in which the work was formerly done, the device in question may be so far superior to equipment formerly used that it has an instant appeal to the observer. He leaves the shop with the feeling that he has learned something of value and on visiting the next shop the impression may remain with him to the extent that, out of personal

interest, he inquires as to the manner of handling the same kind of work in the latter shop. Quite often, in solving the same problem, the men in this latter shop have developed a device which is not only an improvement over their own former method of handling the same work, but a decided improvement over the device which was seen in the first shop visited. And so, as successive shops are visited from time to time there may be observed a number of different devices all designed by individual workmen to accomplish the same piece of work, each one of which may constitute a greater or less improvement over devices previously observed. The existence of so many original ideas and devices for performing similar operations, while of great potential value to the industry as a whole, can never contribute to the fullest extent to the improvement of shop operation until it becomes possible for the worth-while practices of one shop to become the common knowledge of the industry as a whole. The competition between railroads and their shops is not of a nature that should foster a spirit of secrecy regarding the methods of repairing equipment which is common to the entire industry.

There is probably not a railroad man who has attended one or more of the conventions held during the course of a year who has not profited as much by the opportunity of making personal contact with men from other roads as he has by attending the regular sessions of the convention at which the broader problems of railroad operation are discussed. Through this personal contact he learns, in a general way, about the methods that are in use in different shops. A personal discussion regarding shop methods, however, cannot be of as much benefit as personal observation of actual practice. The question that comes to mind at this point is: "Why are railroad shop supervisors not afforded greater opportunities for making periodical inspection trips to other railroad shops as well as through modern industrial plants"? Men in other industries feel that it is an important part of their job always to know what the other fellow is doing.

The statement has been made that the majority of railroad shop men are poorly informed regarding their own jobs as compared with men in other industries. Is this true? If it is, one may readily conclude that either they are interested in their jobs, or else they are not afforded the proper opportunity to broaden their technical knowledge. Systematically-planned and regularly-scheduled inspection trips to other shops and industrial plants will go a long way towards instilling a spirit of progressiveness into a shop supervisor.

Locomotives then and now

In an old publication known as the Mechanics' Magazine and dated Saturday, October, 1829, an interesting account is given of the circumstances leading up to the recognition of Robert Stephenson as the inventor of the first practical, successful locomotive. According to this record, the possibilities of steam transportation were recognized and a company known as the Liverpool & Manchester Railway Company incorporated to operate a railway between these two English cities. The directors of this *great* railway, as it was known at that time, announced that they would give a prize of £500 ($2,433.25) for the locomotive which should, on Tuesday, Oct. 6, 1829, draw on the railroad a given weight with the greatest speed at the least expense.

Among the particular test conditions, were that each locomotive should not weigh more than six tons; that it be capable of drawing a train of carriages equal to three times the weight of the locomotive, itself, at a rate not less than 10 miles per hour continuously for a distance of 70 miles; and that the maximum pressure be not in excess of 50 lb. per sq. in. An interesting side light on this pressure was the reported fact that as far back as 1763, Watt, an advocate of pressures not in excess of 6 lb. per sq. in., called Trevithick (an early inventor) a potential murderer when the latter proposed an internally-fired boiler developing pressures above 10 lb. per sq. in. The Liverpool & Manchester directors, in raising the pressure limitations to 50 lb. per sq. in., initiated a movement looking toward higher steam pressures which has continued throughout the history of steam locomotive development and is particularly pronounced today when a number of locomotives with 350 to 450 lb. boiler pressure are in operation in this country, even higher pressures being used in experimental locomotives abroad.

The offer of so handsome a prize in 1829 attracted wide interest and in almost every part of the country, locomotive makers and inventors set themselves to work to secure the prize. On Tuesday, Oct. 6, 1829, the date of the competition, great crowds of people came from all parts of the country to witness the sight, including a number of engineers and men of science capable of appreciating the exhibition.

The number of competitors was at first expected to be ten, but because of break-downs and other reasons, only five were able to participate. The locomotive which made the first trial was the "Rocket" by Robert Stephenson. It was said to be a large, strongly-built locomotive, weighing four tons, three cwt., which drew an equivalent of three times its weight at a rate of 12½ m.p.h. and with no carriages at the rate of 24 m.p.h.

One other locomotive tested is reported to have darted off at the "amazing" velocity of 32 m.p.h. with no carriages attached, but was weak in construction and proved unable to meet the load requirement. The rest of the contesting locomotives either could not qualify or broke down during the trial, as a result of which, Robert Stephenson was recognized as the inventor of the first practical, successful locomotive.

The "Rocket" with water and fuel, weighed 4 tons 5 cwt. The attached load which was three times its weight, was 12 tons 15 cwt., or a total weight of 17 tons. The approximate distance which it traveled continuously was 70 miles. About 1000 lb. of coke was used as the fuel in the 70-mile run. This amounts to .84 lb. of coke per ton-mile or 840 lb. coke per 1000 ton-miles.

An exact comparison of the performance of the Rocket from a fuel-economy standpoint with that of a modern steam locomotive is impractical, but some idea of the development which has taken place is indicated by the fact that in 1927, a record low monthly average fuel consumption for locomotives in freight service on Class I railroads of 118 lb. per 1000 gross ton-miles (including locomotive and tender) was established. While the number of B.t.u.'s per lb. of coke is usually about 0.8 that of the coal from which it is made, the chances are that the coke used in testing the Rocket contained more B. t. u.'s per lb. than the average coal burned on American locomotives. On that basis, therefore, the average locomotive today is at least seven times as efficient from a fuel-economy standpoint, as the first locomotive successfully to negotiate the rails

A.R.A. standards and recommended practices

The September, 1928, issue of the Bureau of Standards Journal of Research, which is published by the Department of Commerce, Bureau of Standards, contains the report of an investigation made by its research staff of the wearing and mechanical properties of two groups of copper-tin-lead alloys, commonly used for railroad bearing bronzes. This research was initiated at the request of a number of bearing-metal manufacturers who felt that the wide variations encountered in the specifications of different railroads for bearing metals, were opposed to the best interests of the railroads, as well as to those of the manufacturers.

The bronzes were tested under rolling and sliding friction, without lubrication, at atmospheric and at elevated temperatures up to 350 deg. F.; under combined sliding and rolling and sliding friction with lubrication at atmospheric temperatures, and under tension, impact and pounding at temperatures of from 70 to 600 deg. F. None of the selected laboratory tests yielded information which by itself was adequate for general comparisons. Variations in chemical composition of the bronzes produced major changes in properties, but within certain ranges variations in chemical composition were of much less effect than variations in the methods of casting.

The investigation showed, however, that generally chill-cast bronzes were less resistant to wear and impact than sand-cast bronzes, but were more resistant to pounding and tension. An increase in the amount of lead, particularly in the range 0.25 to 10 per cent, improved the wearing properties, but lowered the resistance to pounding, impact and tension. An increase in tin improved all properties. An increase in the temperature of the test generally decreased the resistance to tension, impact, pounding and wear, the changes being most marked from 350 deg. to 600 deg. F.

The manufacturers supported this research work until September, 1927, after which time the support was discontinued. However, the final phases of the program, including most of the mechanical tests, were completed by the staff of the Bureau of Standards, before that time.

In the first group of alloys studied the copper-tin ratio was approximately 92.5 to 7.5 per cent and the proportion of lead was varied from 0.25 to about 25 per cent. In the second group, the copper-lead ratio was approximately 84 to 16 per cent and the proportion of tin was varied from a trace to about ten per cent. It is interesting to note the slight variation between the two groups of alloys selected by the Bureau of Standards research staff and the recommended practice of the Mechanical Division, A.R.A., in which the copper-tin ratio is 87 (approximate) to 5 to 7 per cent. The minimum total of lead, tin and copper is 97 per cent. The proportion of lead varies from 15 to 20 per cent. This is recommended practice for the composition of the back. The composition of the lining includes antimony, arsenic and tin in considerable proportions, in addition to from 85 to 88 per cent lead.

One of the charts included in the report shows the specifications for journal bearings used by 65 railroads in the United States during 1925. It indicates that there are nearly as many different specifications as there are railroads. This situation, especially since the A.R.A. recommended practice specifications were adopted in 1915 and revised in 1926, is difficult to understand since, according to the report, a search of literature and technical society proceedings reveals mostly theories and personal opinions supported few dependable facts. The report also states that records of service tests were conflicting. It is also difficult to understand, considering the findings of the Bureau of Standards, why specifications found to be satisfactory to one railroad appear to be unsatisfactory to another, or why the A.R.A. recommended standard specifications are not used by all the railroads.

Considering all the factors involved and every possible reason why a railroad should use its own specifications in preference to those of the A.R.A., there does not seem to be any real justification for the very wide variation in the specifications of the different railroads for bearings of similar or standard design, subjected to similar service. It is evident from the data contained in the report, that there are unnecessary restrictions known to be best adapted to requirements.

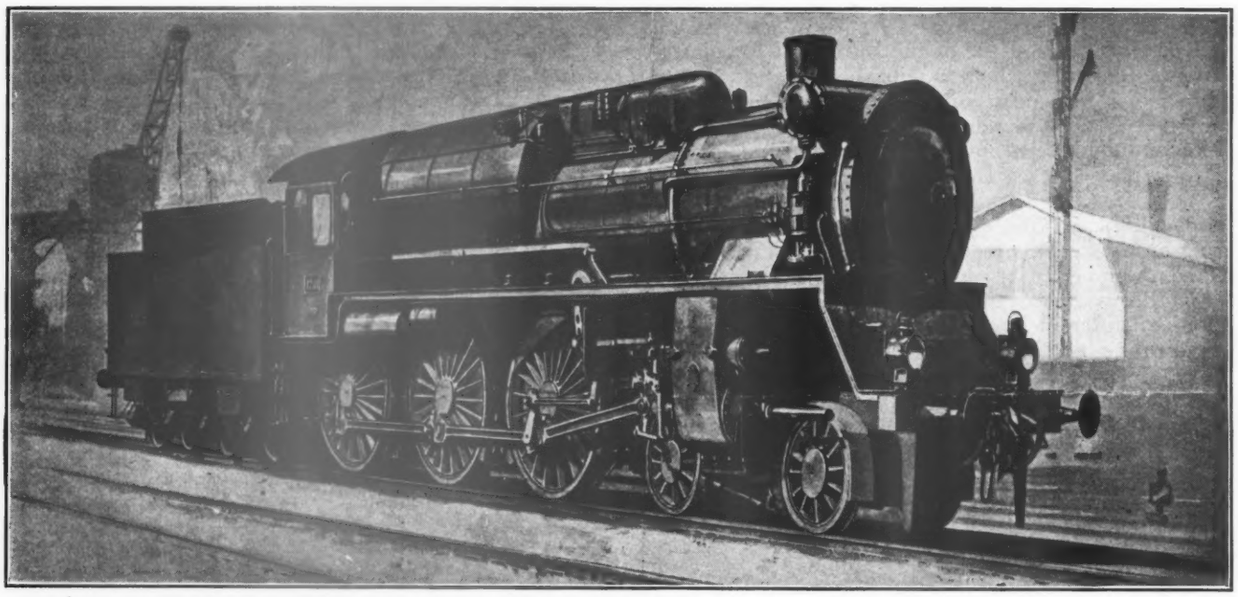
The fact that car journal bearings are replaced on foreign lines with metals varying widely in chemical composition, without causing any difficulty, confirms the viewpoint reached from the laboratory tests that the numerous existing specifications may be revised to good advantage, and brought to conform with A.R.A. recommended practice. Some of the wide variations between the specifications of the railroads and those of the A.R.A. are of relatively little importance. Undoubtedly, improved performance could be obtained by more uniform specifications based on the selection of compositions known to be best adapted to requirements.

Failure of the railroads to conform to A.R.A. standards, defeats one of the most important objects of the association. Every mechanical department officer knows that standards and recommended practices are established to secure economical operation and mantenance. Sixty-five different specifications for bearings imposes a burden on the manufacturers for which the consumer must pay. If such a policy of individual action is extended to many other lines of materials used by the railroads, it must certainly cost a lot of money. It would be a fine thing if the mechanical departments of the railroads in the United States and Canada would study their specifications, ascertain wherein they differ from A.R.A. standards or recommended practices and, if there are no good reasons, established by facts rather than opinions, for the variations, revise the road's specifications to conform to those of the A.R.A.

New Books

PROCEEDINGS OF THE TRAVELING ENGINEERS' ASSOCIATION. *Edited by W. O. Thompson, secretary 1177 East Ninety-eighth street, Cleveland, Ohio. 356 pages, illustrated. 6 in. by 8½ in. Price $1.50.*

The proceedings of the thirty-fifth annual convention of the Traveling Engineers' Association which was held at Chicago, September 13 to 16, 1927, inclusive, contains a complete report of nine addresses and six papers with their accompanying discussions. Papers were presented during the convention on the following subjects: More and better utilization of locomotives; recommended practice of air brake train handling; effect of water treatment on locomotive operation; possibility of further conservation of fuel; the Diesel engine and its like, and value of back pressure gauges and limited cut-off. The book also contains a comprehensive review of the subjects discussed each year since the first annual convention of the association in 1893.



The first Schmidt high-pressure locomotive built for the German State Railways

Schmidt high-pressure locomotive*

Two-pressure locomotive on the German State Railways attains fuel consumption of 2⅛ lb. per drawbar hp. hr. at 50 m.p.h. in road tests

By R. P. Wagner

Superintendent, locomotive department, Deutsche Reichsbahn-Gesellschaft, Berlin, Germany

ALTHOUGH the Schmidt high-pressure locomotive in service on the German State Railways has been mentioned in engineering publications[1] at various times, it nevertheless seems best to preface the description of its present status with an account of the Schmidt process of generating and utilizing high-pressure steam. This is all the more desirable in that it discloses the ingenious way in which the late Dr. Schmidt and his successors evolved a steam-generating method which allowed the use of very high pressures without either calling for unattainable qualities of material or increasing the weight of the boiler to such an extent as to make it useless for locomotive purposes. It would have been an easier task had he been contented with two-thirds of the possible gain and set the limit at 600 lb. boiler pressure, as the general features of the present locomotive boiler could then have been maintained. Overstepping this limit means the necessity for developing a novel type of boiler, yet it opens the way not only to higher economy, but also to higher efficiency per pound of weight.

The Schmidt indirect steam-generating method

The high evaporation temperatures at high pressures (525 deg. F. at 850 lb. and 588 deg. at 1,500 lb.) made it advisable not to expose the most sensitive part of the boiler, the drum, to direct radiation, where its walls might become heated above the evaporation temperature. This Schmidt accomplished by introducing his system of indirect heating, in which a tube system is exposed to hot combustion gases or preferably to radiant heat. This system is filled with distilled water, and the steam generated therein rises into a cooling coil in the high-pressure boiler. In this coil the steam is condensed, transferring its heat to the water of the boiler, and the condensate flows to the bottom of the system through downcomers not exposed to the heat. The system is self-contained and the quantity of water in it never varies except in case of leakage. When the boiler water reaches the boiling point and further heat is transmitted to it, naturally steam is generated and pressure is developed. As the heating system is continuously receiving heat from the furnace and is entirely enclosed, the pressure in it rises higher than that in the boiler, and the difference between the two pressures is such as to provide for a sufficient drop in temperature between the cooling coil and the boiler water. Thus a certain pressure in the heating system (about 1,360 lb) is coordinated with a boiler pressure of 850 lb. for a given area of coil surface and a given quantity of heat transferred. No safety valve is necessary in the heating system, because if more heat is absorbed by it than intended, the pressure rises slightly above 1,360 lb. and consequently the temperature increases, the result being that more steam is generated in the boiler, which is either consumed in the cylinders or blown off through the boiler safety valve.

This steam-generating system which owing to its simplicity is less subject to failure than most other cir-

* Abstract of paper presented by the Railroad Division at the annual meeting of the American Society of Mechanical Engineers, New York, December 5, 1928.

[1] Descriptions of the Schmidt high-pressure locomotive, which is also known as the Schmidt-Henschel locomotive, have been published in the *Railway Mechanical Engineer* issues of January, 1927, page 5; August, 1927, page 531, and August, 1928, page 440. This locomotive was built in 1925 by Henschel & Son, Cassel, Germany, for experimental service on the German State Railways.

culating systems, lends itself very advantageously to the design of a locomotive firebox. Referring to Fig. 1, the heating system forms the walls of a water-tube firebox; the tubes rise vertically from water chambers at the bottom up to the level of the crown sheet. There half of them discharge the rising mixture of water and steam into collecting chambers parallel to the boiler, while the others are bent horizontally, and discharge into the collecting chambers on the opposite side. Firebrick are laid over this archwork to prevent radiant heat and combustion gases from reaching the

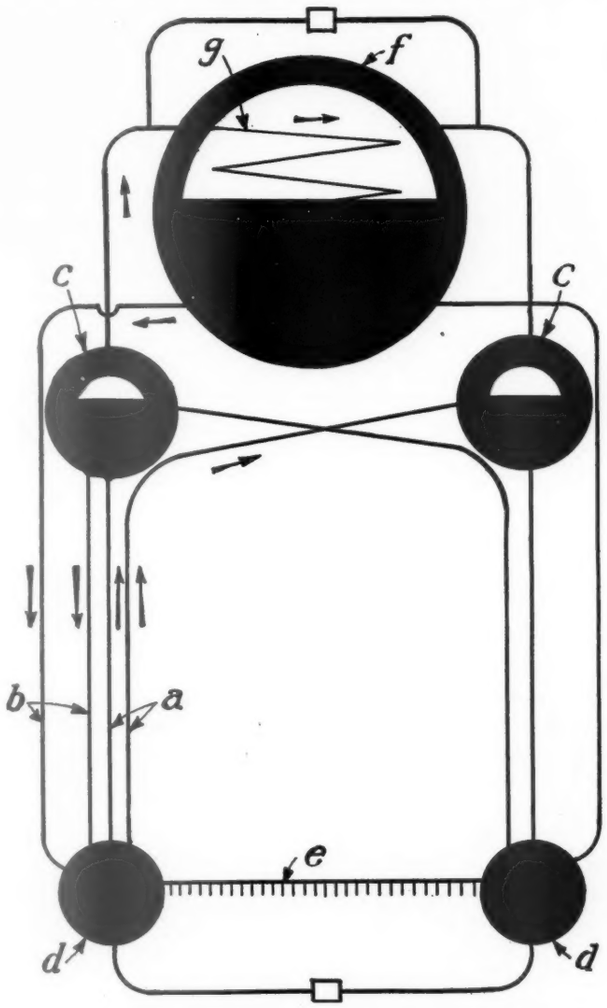


Fig. 1—Diagram showing the arrangement of the Schmidt locomotive firebox

a—steam generating tubes; b—return tubes; c—upper collecting drums; d—water bottom drums; e—firebox; f—850-lb. boiler drum; g—heating coils

boiler drum, which is arranged longitudinally above the firebox. In the collecting chambers the steam is separated from the entrained water, and from their upper part, tubes lead to the coils inside the boiler. The tubes carrying the condensate back to the water chambers at the bottom are so arranged as not to be exposed to radiation and gas circulation.

This system has proved itself to be a thoroughly reliable one for heating a high-pressure boiler, but it should be borne in mind that it is a far cry from a heating system to a locomotive ready for service.

A high-pressure boiler in the present state of development must be designed as a long, narrow drum which will not permit of the usual amount of scale accumulating in it. No one on the designing staff, however cared to incur the troubles of condensation merely for the sake of feeding clean water into the boiler, and to clean a long drum, by blowing off, only, seemed hopeless. So, on the advice of the Schmidt Superheater Company to the author's department the locomotive was provided with a tubular low-pressure boiler, into which the feedwater is first pumped. This boiler is of the ordinary tubular type and carries 205 lb. pressure. In it the feedwater is heated far enough above the temperature at which scale is precipitated to insure practically complete precipitation. From this boiler the feedwater is pumped over into the high-pressure boiler, carrying with it only a small percentage of suspended matter which forms a harmless mud that can be easily removed from the coils by blowing off.

Cleaning the feedwater, though, is not the only advantage of the tubular boiler. Instead of a throat sheet its rear end is a circular tube plate, and the combustion gases are sent through a system of flues like those of an ordinary locomotive boiler into the front end. Their heat is partly used for raising steam at

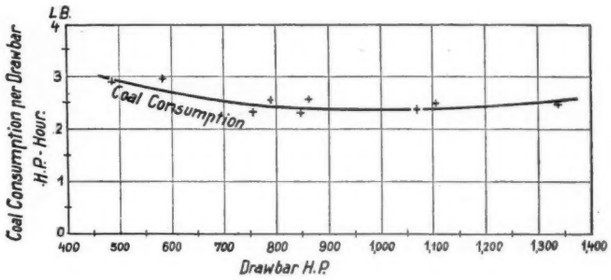


Fig. 2—Coal consumption per hour per drawbar horsepower

205 lb. pressure, and partly for superheating both the high-pressure and low-pressure steam. A pressure of 850 lb. necessitates the use of a compound engine and resuperheating of the receiver steam. On the other hand, a receiver superheater would accumulate more or less lubricating oil entrained from the high-pressure cylinders and clog up with oil coke. For this reason the low-pressure boiler has been designed so as to produce about 40 per cent of the total steam generated. A small portion of this steam is used for the auxiliaries, which it seemed wise to run on low pressure. The major part, however, is highly superheated and mixed with the fairly well saturated exhaust from the high-pressure engine, thus resuperheating it without sending it through a superheater.

It was along these lines that the final design of the locomotive was built in the shops of Messrs. Henschel & Sohn, Cassel, Germany. For testing the system, it seemed sufficient to put a test boiler upon an existing locomotive. One of the older types of the German State Railways, a 4-6-0 high-speed passenger locomotive, seemed especially suitable, as it carried three cylinders and could be easily compounded by converting one of them into a high-pressure cylinder. As two-thirds of all the steam is generated at high pressure and roughly half of the steam energy is utilized in the high-pressure part of a compound engine, one-third of the entire work should be performed by the high-pressure cylinder. For this reason a three-cylinder locomotive was chosen for conversion.

The space occupied by the high-pressure part of the

boiler is practically identical with that of the firebox of any locomotive of the usual design.[2] As the performance and qualitative value of the heating system when applied to intense radiation were not fully known at the time when this locomotive was planned, it seemed wise to subdivide the heating system. By doing so the quantity of steam and water set free by an explosion or leakage would be reduced to a fraction of the total water content. Consequently the heating system was subdivided into six parts. This meant also subdividing the collecting chambers and coils.

Construction of the locomotive

The bottom chambers are arranged all around the grate in place of a mud ring, the sections being clamped to each other so as to form a rigid frame structure. Each chamber consists of a steel block, forged and bored.

From these chambers the heating tubes extend upward, forming the four walls of the firebox; the front-

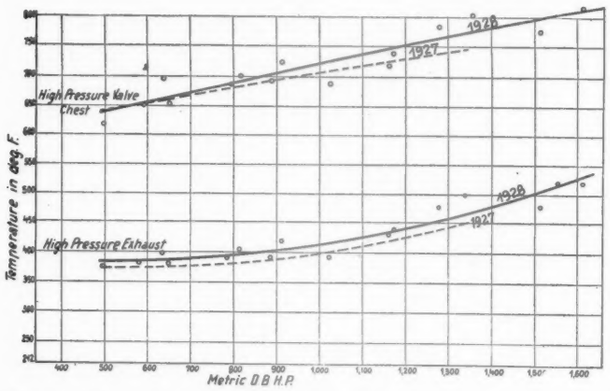


Fig. 3—Mean steam temperature at 50 m.p.h. (1 metric hp. = 0.9863 hp

wall tubes are bent forward so as to form a combustion chamber. The tubes are secured in the chambers by rolling. Welding is not employed, as the joints are subject to bending stresses.

The two upper collecting chambers are 11 in. in diameter and at the bottom enter alternately the heating tubes of their own and of the opposite side; it is here where each individual system is filled with water at the beginning. A bull's-eye water gage indicates the water level when the boiler is cold.

The high-pressure boiler consists of a three per cent nickel-steel drum forged over a steel mandrel. By choosing this heat-resisting, though soft material, it was found possible to keep the thickness of the walls down to 1 13/16 in. A drum of this kind is first forged in the form of a thick-walled tube. It is then roughly machined inside and out, and if no fissures or segregations are found, both ends are shaped in another heat. After that it is machined to size. The heads of the drum are turned on the outside on a lathe, but the tubular part is machined lengthwise on a shaper because of its departure from a circular contour due to reinforcement at the tube connections. All connections of the heating system are arranged on the outer side of the drum so that joint leakage will not empty one of the systems into the drum.

The front-end manhole is just large enough to permit machining the drum inside; the rear one is made as large as possible; and here the coils are inserted, and the boiler inspected and cleaned.

[2] The elevation and plan section of the Schmidt high-pressure locomotive was published in the August, 1928, issue of the *Railway Mechanical Engineer*, page 428.

One of the chief aims in designing was to retain the boiler as the backbone of the locomotive, i.e., to retain the rigidity of the ordinary locomotive boiler. A rigid connection has been attained between the front end of the drum and the low-pressure boiler placed ahead. The drum and the comparatively heavy upper collecting chambers are supported by a number of rigid structural frames extending down to the locomotive frame. These structures are connected with each other by cross-ties, and the structure, as a whole, slides on the frame.

The structural frame supporting the high-pressure boiler makes it easy to provide an airtight sheet-metal casing for the firebox. The tubes of the heating system are loosely suspended in the frame so as to permit free vertical expansion, and are prevented from swinging horizontally by guides.

It was found easier to develop a sufficiently solid connection between the high-pressure system and the locomotive frame than between the high-pressure and low-pressure boilers, both being tubular. Since the low-pressure boiler was to be fitted into an existing locomotive it had to retain some features of the former though obsolete design, i. e., the original diameter and the angle connection between the front sheet and the tube plate. The throat sheet was replaced by an ordinary tube plate. To obtain an absolutely rigid connection between high-pressure and low-pressure boilers the center line of the former was raised as far as possible, and the shell of the latter was dished inward for a distance of 5 ft. from the rear end. The narrow radii on both sides of the inward bulging are heavily reinforced and their tops machined into horizontal faces extending 3 ft. lengthwise. This part of the low-pressure boiler is reinforced against the inside pressure by a longitudinal row of vertical staybolts and by scythe-shaped plates across the top.

Determining the heating surface of the low-pressure boiler was another point of interest. If the steam-distribution gear of the high-pressure and low-pressure cylinders was to be fixed at a definite ratio of cut-off (which seemed more desirable than two independent cut-offs), the relative quantity of steam taken from the low-pressure boiler was bound to vary to a certain extent, at various cut-offs; consequently for a given cylinder ratio the capacity of the low-pressure boiler was so determined as neither to drop too low at a long cut-off (which would mean a useless pressure drop of the exhaust of the high-pressure cylinder), nor to rise beyond the pressure the safety valves were set for, as in this case they would not only blow off the surplus steam raised at 205 lb. but also part of the exhaust high-pressure steam.

Calculation pointed to a heating surface of around 1,200 to 1,300 sq. ft. (exposed to combustion gases), and one of 1,265 sq. ft. was obtained by choosing for the boiler the type E superheater and putting into it 116 tubes of 3 in. inside diameter.

All of the feedwater enters the steam space of the low-pressure boiler close to the top of the forward steam dome, and is sprayed on loosely piled-up grates made from vee-sections which form small troughs. In trickling down from layer to layer the water is quickly heated to a temperature above that at which scale is precipitated. The greater part of the scale is thus deposited upon these racks and the remainder, washed down with the water, remains in suspension as an innocuous mud which slowly settles down on the tubes and boiler plates but never forms a hard, adherent scale. This scale precipitating device has nothing to

do with the design of the high-pressure locomotive; it is part of the standard practice of the German State Railways, and is put into every new locomotive fitted with a feedwater heater. In this case it is doubly useful as it insures fairly clean feedwater for the high-pressure boiler.

The high-pressure superheater occupies 60 tubes of the lower half of the boiler. The live steam enters a cast-steel chamber on the left side of the smokebox. From this chamber 30 units or elements, each inserted into two tubes, lead horizontally across the front end to the collecting chamber placed on the right-hand side. This chamber admits the steam directly into the valve chamber of the high-pressure cylinder.

The low-pressure superheater, which is also of the Type E, occupies the upper 56 tubes of the boiler. All units have a single return bend only, so 56 units in 14 groups are connected with both the saturated and the superheated chambers of a standard header arranged above the superheater. From this header each of the two steam pipes lead, inside the front end, to a mixing chamber, in which high-pressure exhaust and low-pressure live steam are mixed (the former being thus re-superheated), and then to both outside cylinders.

Miscellaneous features of the design

An important part of the design of the locomotive was the task of developing the feed pumps and other boiler accessories for such a pressure. The low-pressure boiler is chiefly fed by means of a piston pump and a closed feedwater heater, both supplied by the Knorr Company and identical with the standard equipment of the German State Railways; the second feed pump is a standard injector. For pumping the water from the low-pressure boiler into the high-pressure part a piston pump seemed more desirable, as the small volume of that part made accurate feeding imperative, so the Knorr Company developed a high-pressure feed pump on the same lines as its standard pump, with two compound steam cylinders arranged in tandem. The cylinders were so dimensioned as to have capacity to pump from atmospheric pressure against 850 lb., but so far it has not been necessary to put in an emergency feeding line from the tank. The usual procedure of taking the feedwater from a comparatively clean part of the low-pressure boiler and feeding it into the high-pressure boiler gave same trouble at first, as the water in the suction line, which was fully saturated with heat, would develop steam during the acceleration period of the pump piston and consequently cause heavy pounding. The suction line therefore had to be led unprotected a short distance, so that the water would cool off a few degrees and thus lose its readiness to evaporate. In regular service one feed pump only is required, but another one of the same type is installed for use in emergencies.

Boiler check and safety valves have been developed on very much the same lines as those of the German standard locomotives, and it is believed that these parts, when properly dimensioned, will give very little trouble at high pressure. A novel device was introduced to relieve the safety valves and to save valuable heat, namely, the blow-off device, by means of which surplus steam is blown from the high-pressure boiler into the water of the low-pressure boiler. There the steam is condensed and its heat saved.

A serious problem at first was the developing of a satisfactory water gage. It soon became obvious that for direct connection with the high-pressure boiler, nothing but a bull's-eye gage would do, so one of this kind was developed. Even then great care had to be taken not to expose the individual glasses to any uneven pressure due to the heat expansion of the enclosing material. As it is, some experience is required to read the gage correctly, especially at night time, and for this reason in addition to two bull's-eye gages a third gage is provided, which is placed on a lower level and connected with the boiler by water-filled pipes. As this gage remains comparatively cold a

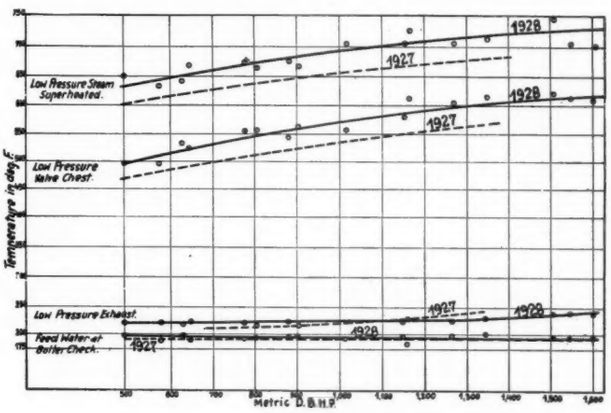


Fig. 4—Mean steam and feedwater temperatures at 50 m.p.h.

cylindrical glass is employed, this glass being filled with fluid of a chloridic nature which does not mix with the water and is colored a bright red.

The only remaining accessory of the high-pressure boiler is the throttle which, according to German standard practice, is placed between the boiler and superheater. This has been developed by Messrs. F. Wagner & Co. and incorporates the same idea of pneumatic coupling between main and auxiliary valves as that underlying its standard design which is put into all German State Railway locomotives. The only difference is that the valve seats are made of Krupp's non-corrosive steel like the same firm's throttles now under test on the Delaware & Hudson's locomotives *Horatio Allen* and *John B. Jervis.* This throttle has from the very first given full satisfaction.

As mentioned earlier, the high-pressure steam is first expanded down to 205 lb. in one of the three cylinders. As all the cylinders of the locomotive are flanged against the plate frame, any one of them might have been converted into a high-pressure cylinder. However, since the inside-cylinder casting serves as the front-end saddle, it affords the best means of access for the high-pressure steam from the smokebox, and for this reason was the one converted.

The new casting was made of a special cast iron of pearlitic structure, and its general outlines were maintained except that the cylinder diameter was made 11 7/16 in. The stroke, naturally, on account of the existing crank axle, had to remain 24¾ in. The distribution gear remained untouched, so the valve chamber had to be placed rather far away from the cylinder. Its diameter is 4¾ in., an ample dimension for the small volume of highly compressed steam.

The piston is a pressed-steel block containing six narrow packing rings. The piston-rod packing which, during the design period, it was feared would present a vexatious problem, consisted of the cast-iron rings which had been standard practice in ordinary locomotives for several years. The only difference was that six rings were put in instead of the usual three. When

the locomotive first pulled out every one was very nervous about the packing; on the third trip, however, we had forgotten that there was such a thing as packing, and we have never been reminded of it since.

The crosshead, inside main rod, and crank axle remained unaltered, just as did practically every other part of the locomotive which has not been mentioned;

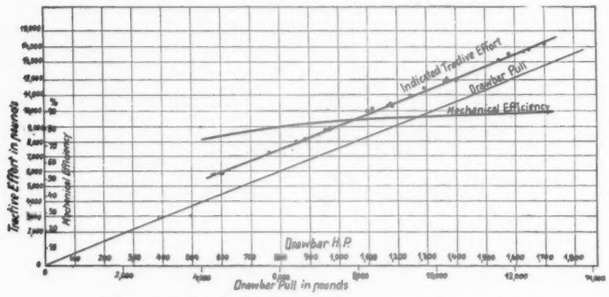


Fig. 5—Mechanical efficiency at 50 m.p.h.

even the angle of 120 deg., at which the three cranks were set was retained. This peculiarity gives to the locomotive a somewhat limping exhaust, as two of the six exhausts during one revolution are dropped out. This irregular sequence is noticeable up to a speed of 7 or 8 miles per hour, but it has not been perceived to have any effect whatever upon the draft at any speed.

Such was the design and status of the Schmidt high-pressure locomotive when, after a number of preliminary runs, it underwent a series of road tests carried out by means of one of the very complete dynamometer cars of the German State Railways. This first series of tests was run in February and March, 1927, on the Magdeburg division, and covered a distance of 101 miles in most cases. Some of the results have been published in the Excerpt Minutes of Proceedings of the Meetings of the (British) Institution of Mechanical Engineers, London, Dec. 16, 1927, and presumably are well known to most of those interested in locomotive development, as they were given in a discussion following the presentation by Lawford H. Fry of a paper dealing with the Baldwin locomotive No. 60,000[3]. Therefore it will not be necessary to repeat more than one of the curves shown at that time (see Fig. 2), namely, the one that interests the locomotive man most, as it represents the coal consumption. It will be perceived that the fuel consumption ranged at all times between 2 and 3 lb. of coal per drawbar hp-hr., with a minimum of 2.25 lb.

A great many more curves of these first tests could be presented, but to no avail, as from the very first it was clearly apparent that the full benefit of the high pressure could then not be obtained for some peculiar reason. As has been mentioned earlier, the firebox was of the long, narrow kind, with a grate 9 ft. in length and scarcely 3 ft. wide. Naturally this design could not be altered owing to the position of the drivers. On the other hand, the heating elements of the firebox were subdivided into six sections so as to make a possible explosion harmless. Each individual heating system had an independent pressure gage in the cab, and it was found from the very first that each system developed a different pressure depending on its position with respect to the grate and the intensity of radiation to which it was subjected. Consequently the systems at the middle of the firebox length, which were closest to the bulk of the coal fired and which received heat from all parts of the grate, developed the highest pressure, whereas the corner sections showed insufficient heat absorption and pressure. This difference in pressure was such that soon the central elements arrived at their hydraulic test pressure, i.e., 1,778 lb. Notwithstanding the high temperature drop the general heat transmission into the boiler proved insufficient to maintain 850 lb. pressure because of the failure of the corner elements. The center elements had too great a heat-absorbing surface for the surface of their recooling coils, while the corner elements had overmuch coil surface for their inactive absorbing surfaces.

Table of dimensions, weights and proportions of the Schmidt experimental two-pressure locomotive for the German State Railways

Railroad	German State Railways
Builder	Henschel & Son *
Type of locomotive	4-6-0
Cylinders, diameter and stroke	11 7/16 in. by 24¾ in. (H.P.) 19⅝ in. by 24¾ in. (Two L.P.)
Cylinders, volume ratio (one hp. cyl., two hp. cyl.)	1:6.5
Valve gear, type	Hensinger
Maximum cut-off, per cent	75 (forward motion) 70 (backward motion)
Weights in working order:	
On drivers	133,900 lb.
On front truck	70,100 lb.
Total engine	204,000 lb.
Weight of locomotive, empty	190,000 lb.
Wheel bases:	
Driving	15 ft. 5 in.
Total engine	30 ft.
Wheels, diameter outside tires:	
Driving	79 in.
Front truck	39⅜ in.
Boiler:	
Type	Two-pressure, experimental
Fuel	Bituminous
Firebox, length and width	109 in. by 35¼ in.
Grate area	26.5 sq. ft.
High pressure boiler:	
Steam pressure	853.5 lb.
Diameter, inside	36 in.
Length	16 ft. 11 in.
Diameter of firebox tubes, outside	2 in.
Diameter of evaporating coils, outside	1½ in.
Water content at lowest level	62.5 cu. ft.
Height of low water above center line	4 in.
No. superheater units	30
Low pressure boiler:	
Steam pressure	205 lb.
Diameter, first ring, inside	67 in.
Length between tube sheets	13 ft. 9 in.
Tubes, number and diameter	116—3¼ in.
Water content at lowest level	127.1 cu. ft.
No. of superheater units	56
Diameter of superheater tubes, outside	¾ in.
Heating surfaces:	
Firebox and combustion chamber	217.8 sq. ft.
High pressure coils	426.3 sq. ft.
Low pressure heating surface, tubes and flues	1,265 sq. ft.
Total evaporative	1,909.1 sq. ft.
High pressure superheating surface	430.6 sq. ft.
Low pressure superheater surface	426.3 sq. ft.
Total superheating	856.9 sq. ft.
Comb. evaporative and superheating	2,766 sq. ft.
Surface of feedwater heater	146.4 sq. ft.
Rated tractive force	33,400 lb.
Weight proportions:	
Weight on drivers ÷ total engine weight, per cent	65.4
Weight on drivers ÷ tractive force	4.0
Total weight engine ÷ comb. heating surface	73.8
Boiler proportions:	
Tractive force ÷ comb. heat. surface	12.08
Tractive force × dia. of drivers ÷ comb. heating surface	948
Firebox heat. surface ÷ grate area	8.22
Firebox heat. surface, per cent of evap. heat surface	11.4

* The original locomotive was built in 1914, by the Vulcan Locomotive Company, Stettin, Germany.

After the tests were completed and had proved that the danger of an explosion of the heating systems was no worse than in any other type of boiler, the locomotive was returned to the makers and they were advised to connect all heating systems with one another so as to equalize the action of the coils. This they did by replacing the subdivided lower and upper collecting chambers by one, extending over the whole length of the firebox. The time in the shop was also utilized to extend both high-pressure and low-pressure super-

[3] The discussion referred to here was that presented by H. B. Oatley, vice president, The Superheater Company, New York, following the presentation by the Railroad Division of Mr. Fry's paper at the spring meeting of the American Society of Mechanical Engineers, White Sulphur Springs, W. Va., May 23 to 26, 1927. An abstract of this discussion was published in the Railway Mechanical Engineer, August, 1927, page 532.

heater units closer to the firebox tube sheet, i.e., to 8 in. distance, as the superheat had been somewhat low.

A general inspection showed that the high-pressure boiler contained no solid scale at all. The only residue was a very thin layer of mud deposited on the coils and the boiler shell. This mud is naturally entirely inactive and is washed off by the turbulent motion of the water. When dried it forms a thin film of dust which is blown off easily. This shows that the boiler-feeding process chosen by the Schmidt Company works satisfactorily, and that condensing operation need not be resorted to in a high-pressure locomotive provided the feedwater is purified in a low-pressure boiler or feedwater heater.

Another series of dynamometer tests were run during the months February and March, 1928, most of them on the same division as before.

In these road tests the department introduced its new system of loading a test locomotive which allows for maintaining drawbar pull and speed even on changing gradients. Instead of a train a specially equipped locomotive is coupled to the rear end of the dynamometer car. The distribution gear of this locomotive (which is held under steam) is fully reversed, the exhaust nozzle is shut off to prevent sucking in gases from the front end, and another port in the exhaust pipe is opened to let in fresh air from outside. This air is compressed in the cylinders and blown off at variable pressure through a hand-controlled valve. To protect the cylinders from becoming heated beyond 850 deg. F. (a temperature reached very quickly by steadily compressing air) hot boiler water is squirted into the exhaust (or in this case, inlet) pipe. This water, which is ready for evaporation, rapidly absorbs the heat raised during the compressing process and holds the temperature down.

The engineman of the brake locomotive adjusts his locomotive so as to maintain the test speed under all circumstances, whereas the locomotive under test maintains an even drawbar pull. Thus the weight of the imaginary train is adjusted in accordance with the varying grades. This method of testing gives results which permit of curves being made of an accuracy never before attained. In combination with a dynamometer car that allows indicating as well as the reading of drawbar pull, speed, work performed, of all temperatures (by automatic resistance thermometers) and of a continuous analysis of the combustion gases, this method can justly be proclaimed to be as efficient as that of any stationary testing plant.

This method of testing, which had formerly been brought up to a standard of high reliability, was exclusively used in finding the curves shown in Figs. 3 to 7, and which are taken from the latest test report.

Fig. 3 shows the improvement in high-pressure superheat over the performance during the first series of tests, and further gives the absolute figures attained. It shows that at 1,500 drawbar hp., 800 deg. F. is practically reached. This performance, considering the air resistance at 50 m.p.h., represents 2,000 boiler hp., the full capacity of the locomotive. In 1927, owing to the imperfect heat transmission, not more than 1,350 drawbar hp. was attained, and, as the curve shows, at a somewhat lower superheat. Because of the higher superheat of the live steam the exhaust temperature is higher than before, and is still considerably above saturation temperature. This serves to relieve somewhat the low-pressure superheater which supplies the extra heat for resuperheating the high-pressure exhaust.

Fig. 4 shows the corresponding figures for the low-pressure steam and the feedwater. The temperature of the low-pressure live steam has risen considerably and reaches 730 deg., a temperature which still could be improved upon, as the low-pressure exhaust line shows. The temperature of the low-pressure steam taken in the valve chest shows that between 100 and 150 deg. are consumed for resuperheating the expanded high-pressure steam. This figure is still open to improvement, as the low-pressure exhaust coincides for a considerable distance with the saturation temperature, and probably includes minor condensation losses. The feedwater curve shows that probably the admission pipe for the exhaust steam is too small for full supply.

Fig. 5 deals exclusively with the recent test series and shows the indicated tractive force based on numerous cards taken simultaneously with all other readings, and the drawbar pull as registered automatically. From these two the mechanical efficiency of the locomotive, ranging from 75 to 90 per cent, is obtained.

Comparisons with later types of locomotives, especially those equipped with a rigid bar frame, reveal the fact that the old-fashioned plate frame, owing to its elastic deformation, gives a somewhat higher motion resistance than a rigid frame system. Ninety per cent was not exceeded with the former, whereas 93 to 95 per cent is by no means an unusual figure to obtain with the latter.

Fig. 6 gives figures on the steam consumption per horsepower-hour. The fact that these curves show a continuous decrease proves that the cylinder volume of the locomotive is large compared with the boiler capacity; the lowest rate per indicated hp-hr. is 13½ lb., and per drawbar hp-hr., 15¼ lb.

Fig. 7 gives the actual fuel consumption per drawbar hp-hr. at 50 m.p.h. The curves show that although in 1927, 2¼ lb. per drawbar hp-hr. was not quite attained, the alterations made brought the consumption down to about 2⅛ lb. The best feature, though, of the 1928 curve is that it is very flat, which means that this low consumption is maintained over a wide range of load.

All these curves were taken at the constant speed of

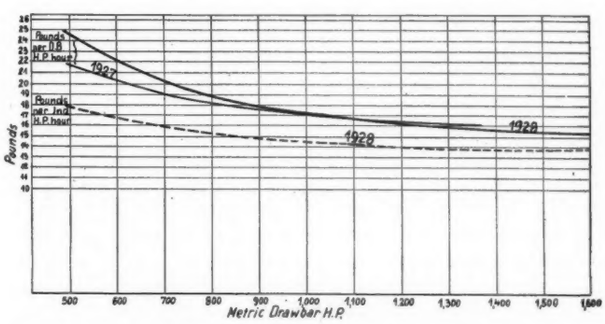


Fig. 6—Steam consumption per drawbar horsepower hour

50 m.p.h., as this speed seemed a good base for judging a passenger locomotive. Readings at higher and lower speeds were taken as well, and these showed substantial agreement from 62 down to 43 m.p.h. Below 43 m.p.h., however, the steam and fuel consumptions rise in proportion to the longer cut-off and the smaller rate of expansion.

More tests will soon follow which should throw light on the working of every detail part of this locomotive; and for this reason the locomotive will remain attached to the testing department. Another locomotive, probably of this same type, will now be rebuilt incorporating some further improvements, and the main feature

will be that the high-pressure portion will be further enlarged at the expense of the low-pressure system. Another locomotive working at 1,700 lb. according to the Loeffler[4] principle is now under construction and expected to be delivered during the coming winter.

The Schmidt high-pressure locomotive which has been described, will, however, always hold the distinction of being the first locomotive designed for such an unusual pressure. It has already proved that great fuel savings

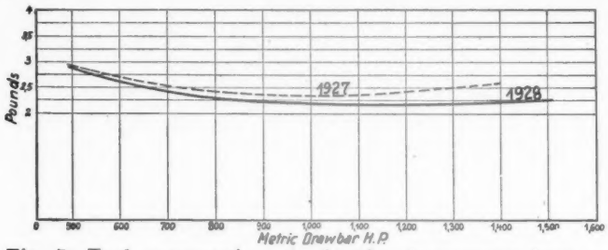


Fig. 7—Fuel consumption per drawbar horsepower hour at 50 m.p.h.

are possible in ordinary service by employing a locomotive which is just as safe as any ordinary type, very little higher in first cost, and just as easily handled by a sensible locomotive engineman as any locomotive of recent design.

Letter ballot returns- Car standards approved

AT the American Railway Association Mechanical Division meeting, held at Atlantic City, N. J., June 20 to 27, 1928, inclusive, the recommendations of six committees were ordered submitted to letter ballot of the members. The results of these letter ballots, made public in circular form by V. R. Hawthorne, secretary of the Mechanical Division, indicated that all committee recommendations received the two-thirds majority requisite for approval except Proposition 2 of the car lubrication committee, relating to dust guards, which has, therefore, been referred back to the committee for further consideration. The most outstanding single feature of the letter ballot returns was the approval of car and locomotive standards, particularly the general designs of hopper cars and automobile-box cars.

Car construction—The recommendations of this committee were divided into 12 propositions. In accordance with the vote approving Propositions 1, 2, 11 and 12, covering the general design of 50-ton and 70-ton hopper cars, and steel frame, double wood sheathed automobile box cars, the Committee on Car Construction will proceed to prepare detailed designs of these cars. In accordance with the favorable vote, Propositions 3 to 10 inclusive, to amend the standard and recommended practice relating to truck details, lumber sections, stake pocket designs, car definitions and designating letters, and standard wheel seat dimensions, have been approved by the A. R. A., effective March 1, 1929.

Locomotive design and construction—The recommendations of this committee were divided into five propositions. In accordance with the favorable vote, these propositions to amend the recommended practice of the division as regards main and other crank pins, driving boxes, engine truck boxes, driving and trailer wheel centers, and locomotive pistons and heads, have, accordingly, been approved by the A. R. A., effective March 1, 1929.

[4] See page 441 of the August, 1928, Railway Mechanical Engineer.

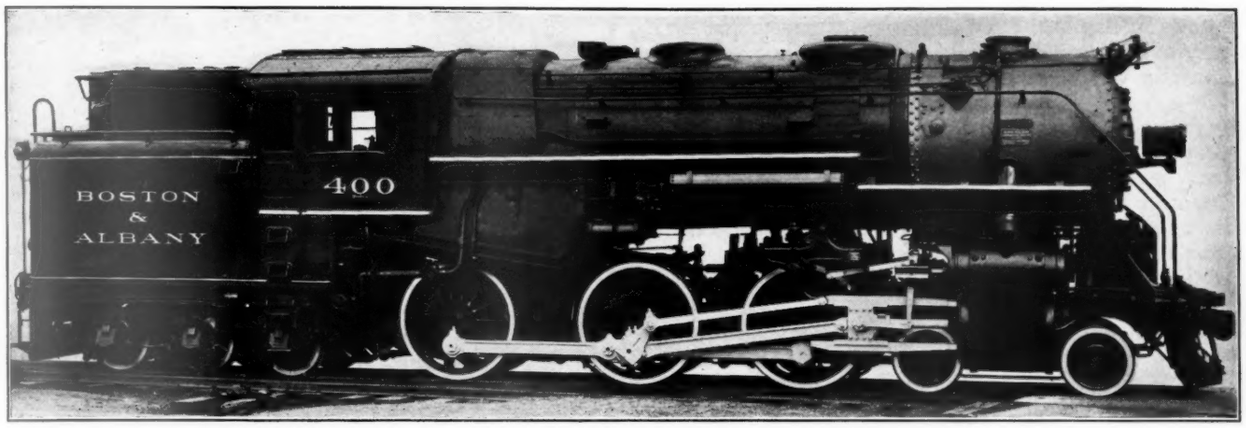
Specifications and tests for materials—The recommendations of this committee were divided into six propositions, two to revise the standard specifications for air brake and train signal hose and four to revise the recommended practice specifications for wrapped and braided air, gas and oxygen hose, chain, coupler knuckle pivot pins and malleable iron castings. In accordance with the favorable vote, these six propositions to amend the standard and recommended practice of the division have been approved by the A. R. A., effective March 1, 1929.

Lubrication of cars—The recommendations of this committee were divided into seven propositions to adopt as standard practice a method of packing journal boxes, specifications for dust guards, journal box packing tools, new waste for journal box packing rules for inspection of journal boxes and passenger car lubrication. All of these propositions, except No. 2 relating to dust guards, which did not receive the necessary two-thirds majority vote for approval and has been referred back to the committee, have been approved by the A. R. A., effective March 1, 1929.

Brakes and brake equipment—The recommendations of this committee were divided into nine propositions: To modify the channel caliper gage, to adopt as recommended practice brake leverage ratios for passenger cars, also tolerances for brake beam camber: to eliminate from the manual the diagram of the No. 1 triple valve test rack, and the conversion of all No. 1 racks to No. 2 racks, by Dec. 31, 1929; to limit the increase in size of exhaust parts of triple valves when rebushed; to modify the recommended practice for steam connections for passenger cars; to restore page 8—1923 to Section E of the manual and to revise page 7—1925; to revise the specification for air hose couplings and gages; to require centrifugal dirt collectors on all cars built on or after June 1, 1929. In accordance with the favorable vote, these propositions to amend the standard and recommended practice of the division have been approved by the A. R. A., effective March 1, 1929. The last proposition, involving modification of the interchange rules, is approved effective June 1, 1929.

Wheels—The recommendations of this committee were divided into six propositions: To adopt as recommended practice the reinforced flange single plate cast iron wheel; to change the title of the cast iron wheel mounting gage for reinforced flange wheel and to remove the old gage from the manual; to adopt as standard the old maximum flange gage for minimum flange and restrict the use of the old minimum flange thickness gage to steel wheels; to adopt the wheel and axle manual as recommended practice; to adopt as recommended practice revised specifications for cast iron wheels; and to revise the wheel defect, worn coupler limit, worn journal collar and journal filet gage. In accordance with the favorable vote, Propositions 1, 2, 3 and 5 to amend the standard and recommended practice of the division have been approved by the A. R. A., effective March 1, 1929; also Proposition 4, involving mostly practices already in effect, has been approved effective as soon as the book can be published and distributed. Proposition 6, to modify the Interchange Rules, has been approved to be effective March 1, 1929.

Locomotive and car lighting—The recommendation of this committee was confined to one proposition, to revise the recommended practice of the division for specifications for axle generator equipment. In accordance with the favorable vote, this proposition has been approved by the A. R. A., effective March 1, 1929.



A 4-6-6 tank locomotive built for the Boston & Albany by the American Locomotive Company

Boston & Albany suburban locomotives

Double-end 4-6-6 tank type with 63-in. diameter drivers—Tractive force of 41,600 lb.

THE Boston & Albany has recently placed in service five double-end locomotives built by the American Locomotive Company which, with the 18 locomotives of this type already in service, makes a total of 23 double-end locomotives hauling suburban trains. The new locomotives will haul ten steel 100-passenger coaches, while the older type will haul only eight steel passenger coaches. They develop a tractive force of 41,600 lb. as compared with 32,550 lb. tractive force for the older design, and are equipped with four-wheel engine trucks, while the older locomotives have two-wheel trucks.

The diameter of the drivers of the new locomotives is 63 in. The diameter of the cylinders is 23½ in. and the stroke, 26 in., and the boiler operates at a working pressure of 215 lb. The total weight of the engine is 352,000 lb. of which 180,000 lb. is carried on the drivers, 62,000 lb. on the engine truck and 110,000 lb. on the tank truck, which carries the fuel and water. The factor of adhesion is 4.32.

The valves are actuated by the Baker valve gear. Cylinder lubrication is supplied by a Nathan six-feed mechanical-type lubricator.

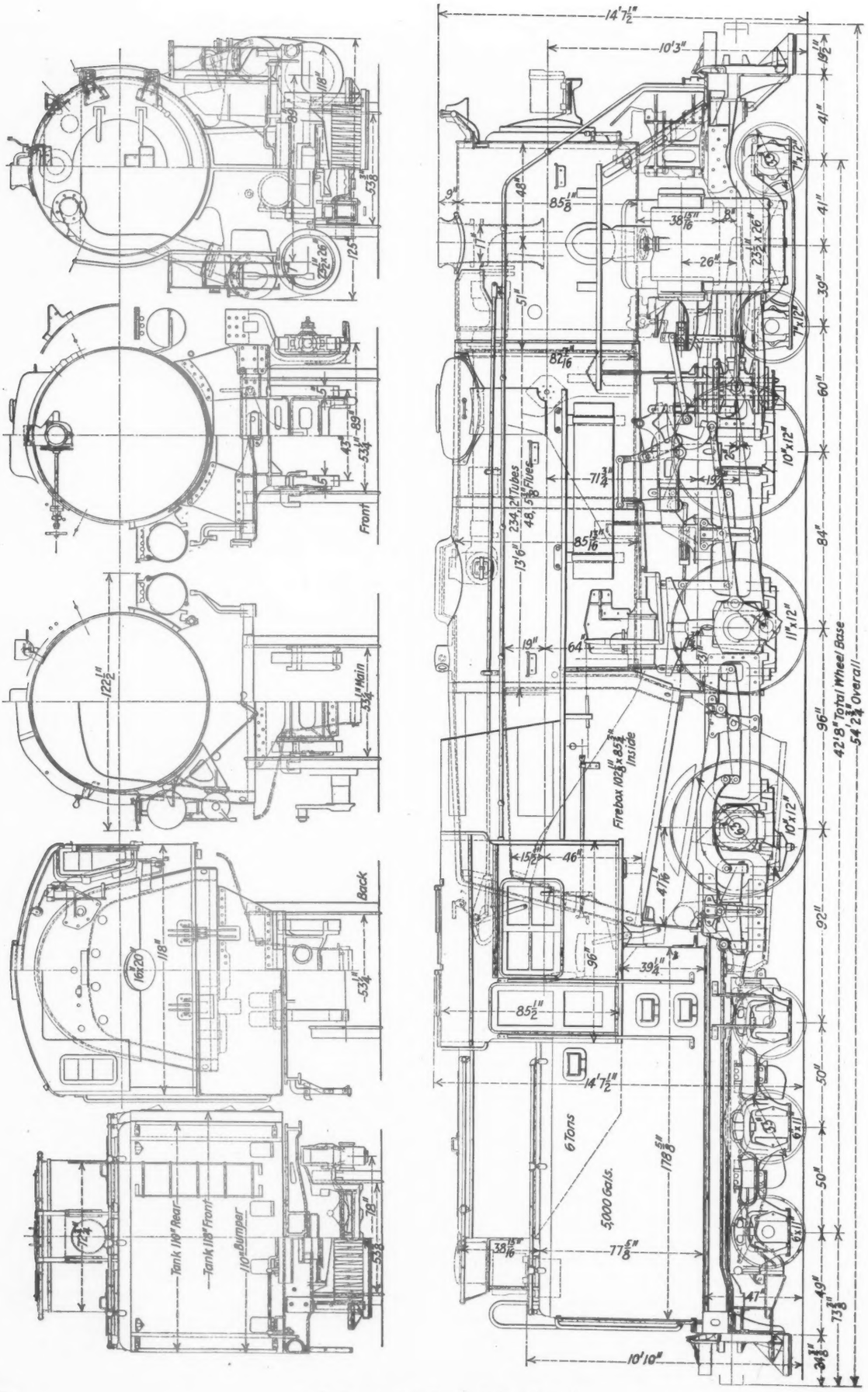
The boiler is of straight top construction and is noteworthy for its liberal firebox proportions. The grate area is 60.8 sq. ft., providing one square foot for each 58.5 sq. ft. of heating surface. The ratio of firebox heating surface to evaporative heating surface, in per cent, is 6.85, which is relatively high for a firebox without a combustion chamber. The boiler has an inside diameter at the first ring of 82 7/16 in. and an inside diameter at the second ring of 84⅛ in. The distance between flue sheets is 13 ft. 6 in. There are 234 tubes 2 in. in diameter, spaced ¾ in., which provide a heating surface of 1,643 sq. ft. The flue heating surface is 905 sq. ft., making a total heating surface of 2,548 sq. ft. for the tubes and flues. The arch tubes have a heating surface of 24 ft. The firebox is 102⅛ in. long by 85¾ in. wide, providing a heating surface of 189 sq. ft. The total evaporative heating surface is 2,761 sq. ft. and the superheating surface is 788 sq. ft. The locomotives are equipped with the Type A superheater.

The smoke box

The smoke box has an outside diameter of 58⅛ in. It is provided with a single exhaust pipe with a maxi-

Table of dimensions, weights and proportions of the Boston & Albany suburban locomotives

Railroad	Boston & Albany
Builder	American Locomotive Co.
Type of locomotive	4-6-6 tank
Service	Suburban
Cylinders, diameter and stroke	23½ in. by 26 in.
Valve gear, type	Baker
Valves, piston type, size	14 in.
Maximum travel	9 in.
Outside lap	1 5/16 in.
Exhaust clearance	3/16 in.
Lead in full gear	5/16 in.
Weights in working order:	
On drivers	180,000 lb.
On front truck	62,000 lb.
On trailing truck	110,000 lb.
Total engine	352,000 lb.
Wheel bases:	
Driving	15 ft.
Total engine	42 ft. 8 in.
Wheels, diameter outside tires:	
Driving	63 in.
Front truck	33 in.
Trailing truck	33 in.
Journals, diameter and length:	
Driving, main	11 in. by 12 in.
Driving, others	10 in. by 12 in.
Front truck	7 in. by 12 in.
Trailing truck	6 in. by 11 in.
Boiler:	
Type	Straight top
Steam pressure	215 lb.
Fuel, kind	Soft coal
Diameter, first ring, inside	82 7/16 in.
Firebox, length and width	102⅛ in. by 85¾ in.
Tubes, number and diameter	234—2 in.
Flues, number and diameter	48—5½ in.
Length over tube sheets	13 ft. 6 in.
Grate area	60.8 sq. ft.
Heating surfaces:	
Firebox	189 sq. ft.
Arch tubes	24 sq. ft.
Tubes and flues	2,548 sq. ft.
Total evaporative	2,761 sq. ft.
Superheating	788 sq. ft.
Comb. evaporative and superheating	3,549 sq. ft.
Tender:	
Water capacity	5,000 gal.



Elevation and cross sections of the Boston & Albany suburban locomotive

Fuel capacity		6 tons
Rated tractive force		41,600 lb.
Weight on drivers ÷ tractive force		4.32
Boiler proportions:		
Tractive force ÷ comb. heat. surface		11.72
Tractive force × dia. drivers ÷ comb. heat. surface		738
Comb. heat. surface ÷ grate area		58.5
Firebox heat. surface ÷ grate area		3.2
Firebox heat. surface, per cent of evap. heat. surface		6.85
Superheat. surface, per cent of evap. heat. surface		28.5

mum tip diameter of 6⅜ in. A recess is provided in the smoke box to receive the American multiple front-end throttle.

Mechanical details

The back ends of the main rods and the main pin connection of the side rods are provided with floating bushings. The engine and trailing trucks are the Commonwealth constant resistance type. The trailing truck rockers are proportioned so that the resistance at the rail equals that of the front truck. The locomotives are also equipped with the Commonwealth cast steel ash pans and bumper beams.

The tank frame is cast integral with the rear section of the main frame to which the front frame sections are bolted. The cylinders are also of cast steel.

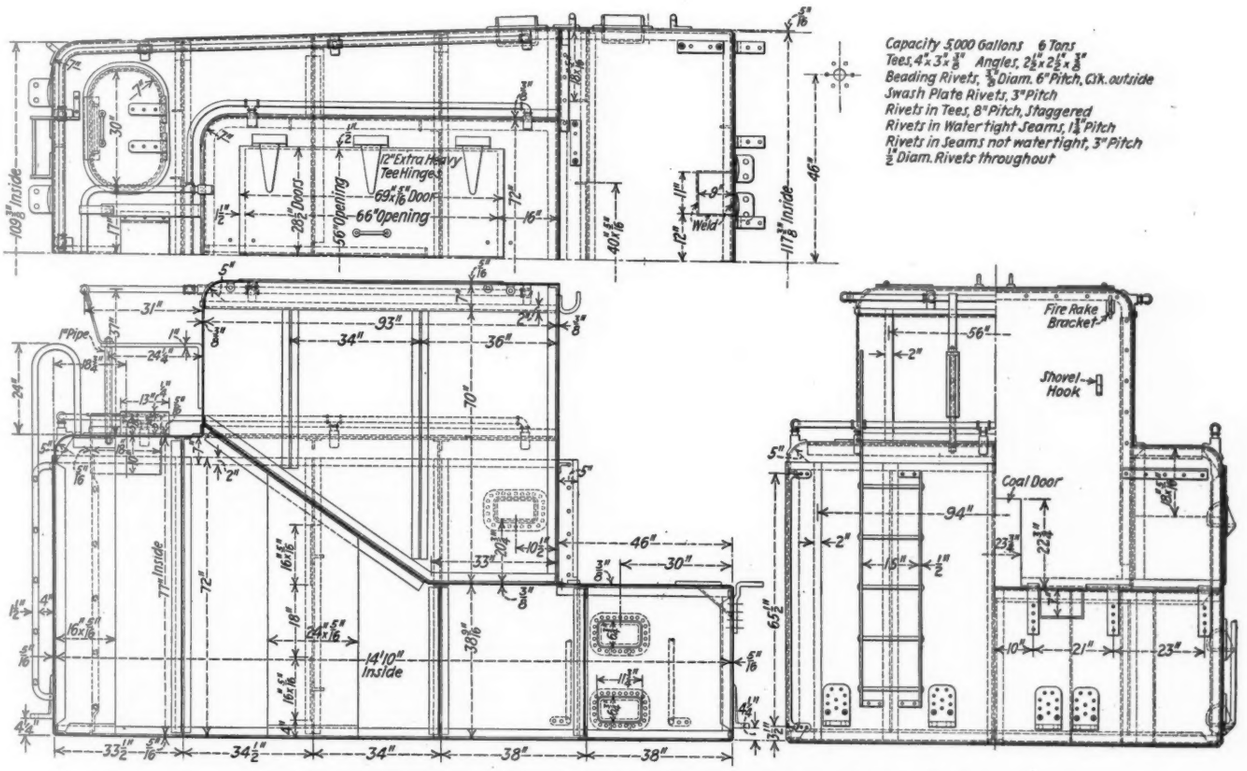
The sand traps and pipes are located beneath the jacket. Sliding cover plates set in the jacket provide ready access to the traps. The steam turret valves are completely covered by a hinge-type casing, located directly in front of the cab. The boiler jacket, cab and tender are finished with lacquer.

The boiler and tender are carried on a continuous frame, which gives a rigid wheel base 42 ft. 8 in. long. This construction results in a long overhang extending from the rear pair of drivers to the rear of the tender. As a result of this overhang, it was necessary to taper the tender from the cab to the rear in order to obtain necessary clearances when rounding a sharp curve.

The tender has a capacity for 5,000 gal. of water and six tons of coal. The bunker is provided with a cover consisting of two doors made of 5/16-in. plate, hinged at the sides. The sides of the coal bunker are curved inwardly at the top, as shown in the drawing, and the opening for filling the bunker with coal is 66 in. by 56 in. This arrangement, in which the coal bunker is entirely enclosed when the doors are down, eliminates the annoyance caused by coal dust and small particles of coal being carried into the cab when running backward. The opening into the water tank is located on the left side of the tender.

Train control equipment

The locomotives are equipped with the General Railway Signal Company's intermittent type automatic train control. As the locomotives are operated in either direction, an impulse receiver is located on each side of the cab. A reversing mechanism is located on the middle axle of the six-wheel tank truck. This device automatically changes over the flow of current with a change in the direction of motion.


Capacity 5,000 Gallons 6 Tons
Tees, 4" x 3" x ⅜" Angles, 2½" x 2½" x ⅜"
Beading Rivets, ⅝" Diam. 6" Pitch, C'sk. outside
Swash Plate Rivets, 3" Pitch
Rivets in Tees, 8" Pitch, Staggered
Rivets in Water tight Seams, 1¾" Pitch
Rivets in Seams not water tight, 3" Pitch
⅞" Diam. Rivets throughout
12" Extra Heavy Tee Hinges
69" x ⅜" Door
66" Opening
Weld
Fire Rake Bracket
Shovel Hook
Coal Door
14'10" Inside

Tank construction of the Boston & Albany suburban locomotives

AUTOMATIC DIES.—An attractive four-page bulletin, announcing the new 8H and 10H Hartness automatic dies, has been issued by the Jones & Lamson Machine Company, Springfield, Vt. These dies range in capacities from 1½ in. to 2½ in. and from 2 in. to 3 in., respectively.

SILENT GEARS.—The manufacture of fabroil and textolite and the application of these materials to gears of high-speed machinery to eliminate the noise which results from running metal gear-trains at high rates of speed, are described in the 32-page illustrated booklet issued by the General Electric Company, Schenectady, N. Y.

Laws of management applied to manufacturing

TWENTY-FIVE years ago when Frederick W. Taylor first announced his principles of industrial management, the organization and control of the operation of manufacturing facilities in this country entered a new era of development. It is not surprising that at the outset those who were dazzled by the application of the term "scientific" to a new field were led by their enthusiasm into many excesses. The reaction from these excesses has, perhaps, left a deeper impression on the railroad field, as far as the new profession touched that field, than in the more strictly manufacturing industries.

The mistakes which were then made grew out of the assumption that the new science was born with its full growth and maturity. Methods received the homage due only to well-tried and thoroughly-established laws. The assumption was made that the problems of management were solved the moment scientific principles of analysis were applied to them. As a result of these fundamental errors of attitude, methods were applied in some cases beyond the scope of common sense and too much emphasis was placed on those elements in the field of management which were then most readily susceptible to quantitative measurement. A deep-seated resentment was thus created in the minds of workers through the concentration on motion study and wage incentives in the effort to increase the output of the worker, without sufficient regard to other factors and responsibilities affecting production.

It is, therefore, quite possible that any attempt at the statement of the principles of management in the form of laws, with all the implications of universal application which this implies, will be received with a smile of skepticism by the railroad shop managers and supervisors.

A perusal of L. P. Alford's new book, Laws of Management Applied to Manufacturing,* however, quickly discloses that much water has gone over the dam in the 25 years since Taylor first suggested the possibilities of the application of scientific methods to the problems of management in the manufacturing industries. The early authorities in this field found no hesitancy in enunciating principles at the outset of their work. On the other hand, the approach of the author, who, formerly as editor of Industrial Management and now as editor of Manufacturing Industries, has long been a close student of developments in the field of management, is to see whether, after 25 years of experience, it may not now be possible to formulate certain principles, proved by experience, which may be considered fundamental. A further evidence of this change in attitude is that the author finds, instead of a few principles in which each of the early management engineers attempted to compress the fundamentals, that "a steady accumulation of evidence *** and the very complexity of the application of management methods indicate the existence of many, rather than few, fundamentals." The book sets forth no less than 45 formally stated laws; corollaries and less definitely formulated principles bring the total to something over 50.

These principles or laws, from the very fact that they may qualify as such, will prove disappointing to the person who looks to them for a method by which he may solve his immediate problem. Diversity of conditions is likely to restrict the application of any method to a very limited field. A fundamental law must be broad enough to take in all the varied methods by which it may be put into action. Again, one finds some of these laws axiomatic; they are precisely what common sense would dictate. In other cases, the attempt to formulate a general principle has led to a statement so involved as to obscure its meaning in the practical terms of any given situation. One may also suggest that these laws possess fundamental qualities in somewhat varying degrees. Some of them may never need restatement, while others may at some time require modification or complete restatement. For instance, one of the laws of mass production is stated thus: "Large scale production tends to increase operating efficiency and competitive power." While such a point may nowhere yet have been reached in practice, it is conceivable that the law of diminishing returns may at some time reverse this tendency with respect to operating efficiency.

The term "scientific management" as applied to the railroad field, or, at least, in the railroad shop where conditions most nearly approach those encountered in manufacturing industries, has generally been confined to planning and scheduling and to various systems of wage incentives. The relatively small part which these are of the whole is well brought out by the author in his discussion of recent progress in management. He cites the results of the application of management methods at the Newport News Shipbuilding and Dry Dock Company for a period of five years.

Various changes were made successively during this period so that the effect of each could be segregated. Out of a total cost reduction during the five years, estimated at 21 per cent, wage incentives, and planning and scheduling methods together accounted for 4.6 per cent. The largest single saving was effected in material control, amounting to 4 per cent, and the next—cost budgeting—amounted to 2.5 per cent. Other departments in which methods were improved, effecting reductions varying from 1.6 per cent down to .5 per cent each, are set forth in the order of their value: Plant engineering and equipment; engineering and design; purchasing; inspection; stores keeping; standardization; employment and training, and time keeping.

This list is suggestive of the scope of the laws of management as set forth by the author, and to it must be added the laws covering leadership and executive work.

The formal application of the entire body of principles of management in the railroad shop is quite a different matter than in the manufacturing industries because the functions of management as applied in the industries are scattered among several departments of the railroad to which the production problems of the shop are but incidentally related. In the matter of material control, for instance, both the shop and the stores department are involved, and purchasing is entirely out

* Published by the Ronald Press Company, New York. 6 in. by 9 in., 266 pages, illustrated. Price, $4.00.

of the shop atmosphere, so to speak. Even a casual reading of the Laws of Management, however, will suggest to one familiar with recent trends in the maintenance of railway rolling stock that methods in keeping with many of these principles, other than those most commonly associated with the idea of scientific management, are being developed. A change from decentralized to centralized shops conforming to the laws of production management is now under way, with trends in increased productivity of the worker quite in keeping with those experienced in manufacturing industries. The remarkable work of the stores department in reducing stock balances and increasing working capital turnover is also worthy of attention in this respect.

As to the fundamental nature of all management laws, the author suggests that they are the result of evolution, with roots deeply embedded in the evolution of human society itself. In biology, evolution is a process inherent and inevitable in its nature, over which creatures, individually or collectively, exercise no conscious control. Can that be true of evolution in management methods? If so, what control has been exercised over the tremendous changes in American industry since the war (changes which, the author points out, have increased the productivity of the American worker by more than 50 per cent since 1921)? Perhaps none, so far as the fundamental character of the development itself is concerned, but a tremendous influence has been exerted on the rate at which this development has taken place.

Continual improvements in the management of manufacturing organizations and processes demand a widespread knowledge of the fundamentals underlying the improvements made during this remarkable period of increased productivity. There can be no doubt but that management has become a science and has ceased to be the kind of an art which is the expression of unguided natural talent. Mr. Alford's book, in addition to its code of laws, presents a stimulating birdseye view of the developments of 25 years in all branches of the field of management, and traces their origins back to the activities of antiquity. It must also be said that most of the laws as stated possess practical value for clarifying one's approach to his own problems, particularly in evaluating those problems in their relations to each other.

An analysis of the design of crosshead guides

A proposed method of determining the normal loading, stresses and deflections is discussed

By C. H. Faris

Draftsman, motive power department, Norfolk & Western, Roanoke, Va.

IN order to ascertain what bearing, if any, the design of crosshead guides might have on certain failures that were occurring occasionally on locomotive guides in service, it was decided to make an analysis of the normal loading, stresses and deflections of the guides on all of the locomotives on this road and tabulate the results for comparison and study. After the work was completed, it was thought that the methods of analysis developed and the results found, might be of general interest, and for this reason the following description of the investigation and findings was prepared.

Load due to rod thrust

Practically the only normal loading for which a crosshead guide must be designed is the vertical loading due to the connecting rod thrust. This depends upon the value of the piston thrust and the angularity of the rod, or the ratio of the crank radius to the length of the connecting rod.

The bearing area of the crosshead against the guide must be great enough to keep the unit bearing pressure of the sliding surfaces below a certain limiting amount to avoid heating. The usual maximum value to design for is about 100 lb. per sq. in.

The vertical thrust of the crosshead against the guide produces a bending of the guide, the stress from which should not exceed about 8,000 lb. per sq. in. The guide deflection from this load should not be excessive but it will usually be within permissible limits if the guide supports are sufficiently rigid and the bending stress is kept within the value above specified.

The above outlines the conditions of usual practice in the design of guides. Following is a detailed explanation of the methods of computation used to determine the quantities for a measure of the sufficiency of the design as found on the different given locomotives.

Typical results obtained from the investigation of six classes of locomotives

Class of locomotive	Cylinder, diam. and stroke, in.	Steam pressure,	P, Piston thrust, lb.	T, Crosshead pressure, lb.	Crosshead bearing area, sq. in.	Guides: Unit pressure, lb.	Guides: Bending moment, in.-lb.	Guides: Bending stress, lb.	Guides: Deflection, in.
E2	22½ by 28	200	79,522	10,686	120.0	89.0	64,300	4,830	.008
J	19 by 28	200	56,706	6,426	90.0	71.4	61,500	5,840	.014
K2	28 by 30	200	123,150	20,326	210.0	97.0	269,000	17,550	.015
M2	24 by 30	200	90.478	15,930	180.0	88.6	172,000	10,740	.008
Y3	25 by 32	240	117,809	17,971	145.0	124.0	270,000	9,130	.033
Z1	22 by 32	225	85,529	13,835	130.0	106.0	179,000	15,270	.076

The first step is to compute the crosshead reaction, or thrust, against the guide. A formula which gives a very close approximate value for this maximum pressure is:

$$T = \frac{P(R+C)}{L}$$

Where T is the thrust of the crosshead against the guide, P is the piston thrust found by multiplying the area of piston by the steam pressure, R is the crank radius in inches, C is the amount the centerline of cylinders is raised above from the centerline of the drivers and L is the length of connecting rod in inches.

For the average case, the results given by this formula differ from the true theoretical value by about one eighth of one per cent. The maximum value of T occurs, of course, when the angle of the connecting rod with the horizontal is at maximum or approximately at half stroke. Furthermore, this value is obtained only when the steam cut-off is 50 per cent of the stroke or more.

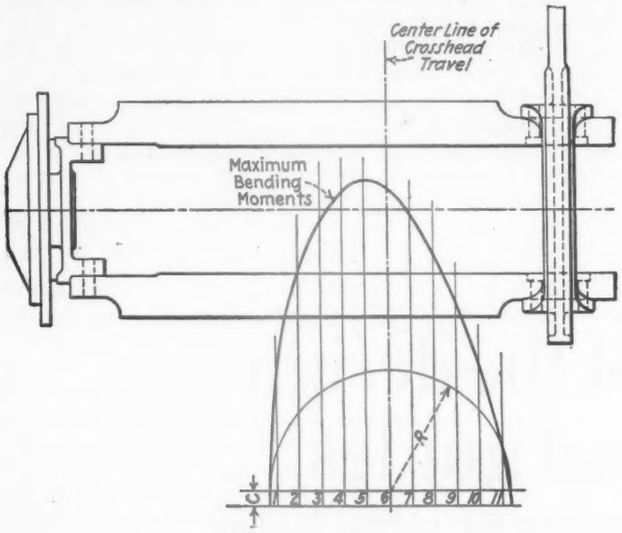


Fig. 1—Guide supported at the ends

For short cut-offs the crosshead pressure is less, but the guides must be designed for the maximum pressures. Even for full steam pressure on the piston throughout the stroke, the guide pressure decreases progressively each side of mid stroke so that for any other position,

$$T = \frac{P(R \sin \theta + C)}{L}$$

where θ is the angle the crank radius makes with the horizontal.

Method of support an important factor in calculations

Most guides may be divided into two classes as regards methods of support. One where the guide is supported approximately at the ends, as in Fig 1, and the other in which the supports are located one at one end and the other near the center of the guide, as shown in Fig. 2.

The maximum bending moment on a guide does not necessarily coincide with the position of maximum pressure of the crosshead. In some cases, for guides supported at the ends, where the center of the guide supports does not coincide with the center of the stroke of the crosshead, the bending moment on the guide may increase faster as the crosshead moves towards the center of supports, than the crosshead pressure decreases as it moves past mid stroke. For guides with a support near the center, the bending moment on the guide may be a maximum when the crosshead pressure is a maximum if this maximum occurs at the support.

A graphical analysis

A diagram whose ordinates are proportional to the thrust of the crosshead against the guide may be drawn, as shown in Figs. 1 and 2, by drawing a semicircle with a radius equal to R, over or under the guide drawing, with the center coinciding with the mid position of the crosshead stroke. If now a line is drawn a distance C below the center of this circle, then the mid-ordinate of the diagram is $R+C$ and the ordinate at any other position of the stroke is $R \sin \theta + C$.

By scaling a sufficient number of ordinates at regular intervals from the diagram and multiplying these values by $\frac{P}{L}$ the pressures of the crosshead at these points may be found. From these, the corresponding bending moments on the guides may be computed and the maximum bending moment determined.

The curves marked, "maximum bending moments" in Figs. 1 and 2 are found by plotting the values of the bending moments produced by the crosshead pressures in the successive positions of the crosshead at those points, the forces producing these moments being proportional to the ordinates of the semicircular diagrams as shown.

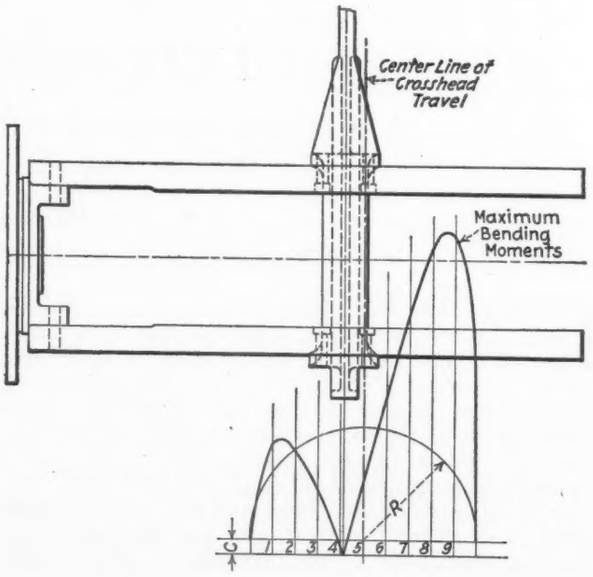
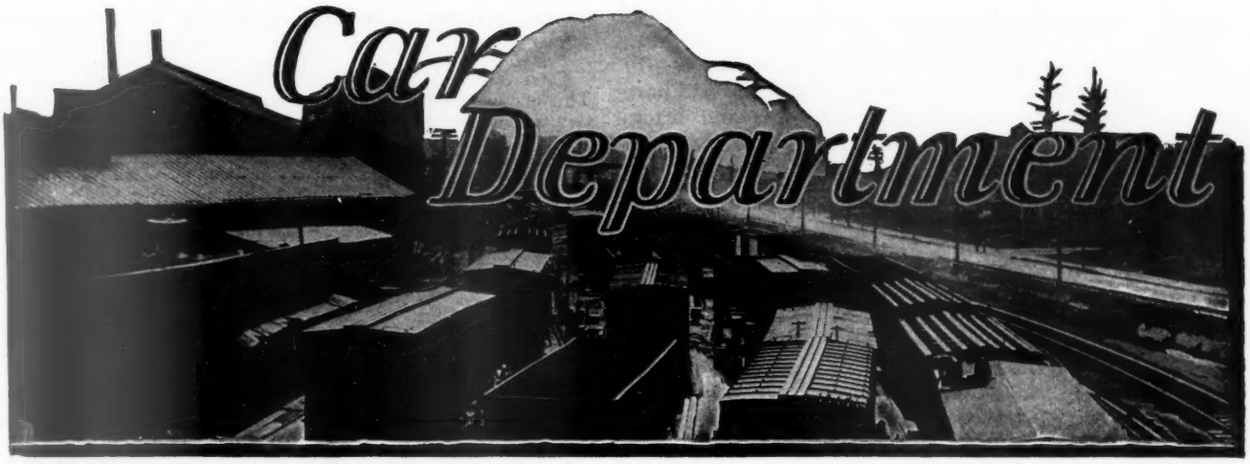


Fig. 2—Guide supported near the center

After finding the maximum bending moment and the load producing it, the deflection of the guide may be computed by use of the usual deflection formulas. The maximum bending stress is found by dividing the bending moment by the section modulus of the section of the guide.

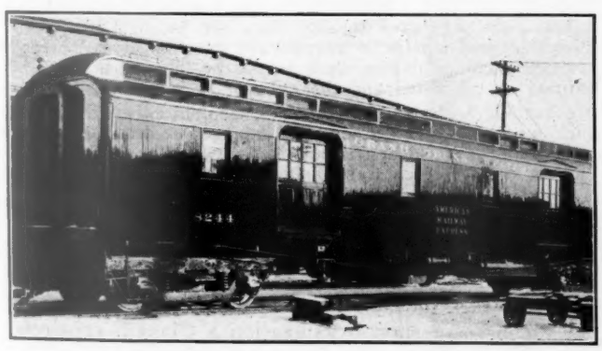
Typical results of the investigation for several different classes of locomotives are shown in the table. Not all the data that was collected is shown in this table. Comparison of the results with breakage reports pointed in some cases to a relation between design and failures, but in other cases inconsistencies suggest that other factors may have a greater influence on some failures than the design.



Passenger car repairs on the Grand Trunk Western

Repair shop at Port Huron, Mich., organized to turn out an average of 12 heavy-repair cars a month

ONE of the principal car repair shops of the original Grank Trunk lines has been located at Port Huron, Mich., for many years. During the winter of 1914-1915 the original shops at that point were destroyed by fire and the present shops, which were completed in 1918, were built at some distance from the location of the old shops. The existing facilities were constructed with a view to handling the major car repair work for the original Grand Trunk system but since the consolidation of the system with the Canadian National the work at that point is confined

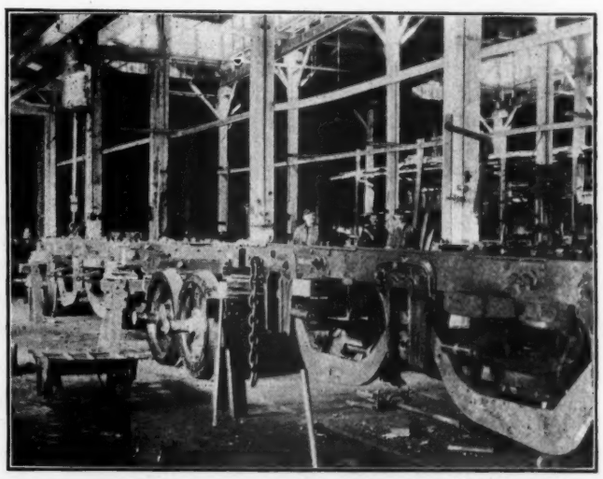


A wood express car on the inspection pit under steam while undergoing final inspection

to the car repair work occasioned in the maintenance of 185 passenger train cars in the service of the Grand Trunk Western and some few additional cars which are used on the Canadian National lines in international train service. As a consequence it may be appreciated that the facilities at Port Huron shops have a capacity somewhat in excess of that required to handle the maintenance work on passenger cars as the demand exists at present.

The shop facilities

The passenger car shops include two buildings, the larger of which is 134 ft. by 303 ft., with a capacity of 15 cars, and the smaller 134 ft. by 240 ft., with a capacity for 12 cars. These shops are so designed that each car occupies one bay with an ample allowance for working space. The two buildings are parallel to each other with a 100-ft. space between, in which is located an 80-ft. electrically operated transfer table. Both

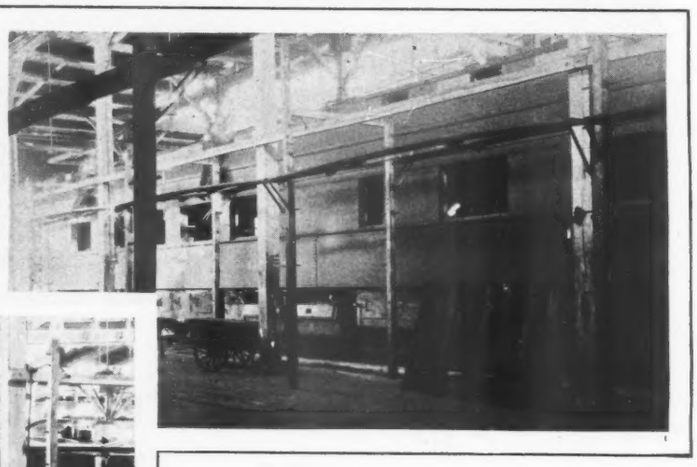


The trucks are raised to a working height during repairs

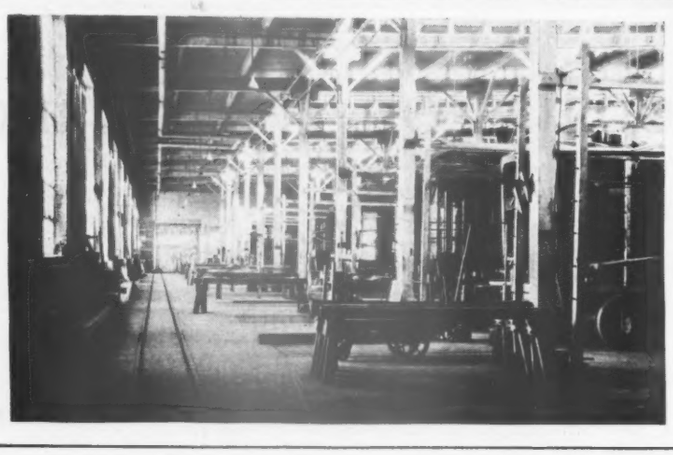
buildings are of concrete and brick construction with wood framing. At one end of the smaller shop there is a two-story building on the ground floor of which is located the upholstery shop, the tin shop and the plating room. Above the upholstery shop is the cabinet shop and on the opposite end of the second floor is the

varnish room. An electric elevator is provided in this building.

The shop layout at Port Huron is complete for freight and passenger car repair work and the additional facilities include a wood mill, machine and blacksmith shop, paint mixing and store room, electrical shop, steel and wood freight car shop and general car material storehouse. A power plant furnishes the steam and air for the shops.



A view in the coach shop showing the type of adjustable scaffold used



Looking down the coach repair shop

Shop organization

At the present time the organization assigned specifically to passenger car repairs consist of about 85 men, including supervisors but not including clerical help. Reporting direct to the shop superintendent, who has charge of all car repair work at that point, are departmental foremen in charge of the coach shop, painting, upholstery shop, electrical shop and the pipe and tin shop. In the coach shop there is a gang foreman, a shop inspector, one truck repair-gang leader, one template maker, 34 coach repairmen, one coach carpenter apprentice, three material handlers and five in the plating room, one mechanic and a helper. In addition there are four men in the steel shop assigned to the paint mixing room. In the upholstery department there are three upholsterers and three helpers and in the plating room, one mechanic and a helper. In addition there are four men in the steel shop assigned to passenger work. The electrical shop has a gang leader, three electricians and three apprentices.

The work of the machine shop, blacksmith shop, wheel shop and wood mill is handled on a shop-order basis and the charges for material made or repaired are distributed to the passenger or freight car repair accounts in accordance with the work handled.

Classification of repairs

All of the passenger car repair work on the Grand Trunk Western is handled under the following classification:

Class No. 1—Running repairs, labor not to exceed 16 hours. This includes repairs made in train yard or on repair tracks which can be accomplished in the time specified. Bolts, bearings, cleaning triple valves and brake cylinders, brake beams, brake rigging and safety appliances.

Class No. 2—Light repairs, labor 16 hr. to 96 hr. Includes light repairs such as the changing of wheels, application of pedestals, repairing brake rigging, leaking roofs or doors.

Class No. 3—Medium repairs, labor 96 hr. to 480 hr. Includes interior and exterior repairs which can be accomplished in the time specified. No car is to be included in this class unless the exterior is varnished.

Class No. 4—Heavy repairs, labor 480 hr. to 1,440 hr. Includes general repairs to interior and exterior of car. No car is to be included in this class unless the interior is varnished, painted or renovated and the exterior is varnished.

Class No. 5—Extra heavy repairs, labor in excess of 1,440 hr. Includes repairs to a car seriously damaged or deteriorated, with underframe and superstructure badly twisted or broken. Rebuilt or remodeled cars are included in this classification.

The greater part of the repair work at Port Huron consists of cars that are given repairs in Classes 3, 4 and 5 and the shopping schedule of first-class equipment is arranged so that a car is given Class 4 repairs on an average of each 18 to 20 month of service. Under the present shop organization a Class 5 repair job requires from 33 to 41 days in the shop while a Class 4 repair can be made in from 23 to 29 shop days. When undergoing Class 5 repairs a passenger coach requires from three to five days for cleaning, stripping and scrubbing; about 15 days for the repair work; from 8 to 16 days for painting; four days for trimming and a day for final inspection and testing. On a Class 4 repair job the time for the above operations is reduced to about six days for the repair work; from 8 to 14 days for painting; three days for trimming and a day for final inspection and testing.

Considering the repair work on a coach as typical of

the shop work it will give a general idea of the shop operation to follow such a unit through the shop while it is undergoing Class 4 repairs.

How the work is handled

Upon arrival at the shop the car is given a careful inspection by the coach shop and painter foreman in order to determine the class of repairs it shall receive. It is then routed to an outdoor inspection and cleaning pit located adjacent to the coach shop. The pit is similar to a locomotive inspection pit, being of such length as to accommodate the longest car in service, about 4 ft. in width and 39 in. in depth below the top of the rail. The pit is piped for steam, air and water and drained. The practice of cleaning cars over this pit before taking them into the shop serves not only to keep the dirt out of the shop but makes it possible thoroughly to clean otherwise inaccessible places underneath the cars.

When the car has been placed over the pit the car body is jacked up and the trucks are removed. The regular trucks are then taken to the truck shop which is located in the large shop building adjacent to the pit. Auxiliary shop trucks are placed under the car and it is moved into the shop where it is completely stripped of all fittings and trimmings. The car is then returned to the outside cleaning pit where the interior is thoroughly blown out with air to remove all dirt and dust from corners and in such places as between the windows. The exterior is blown down and the underframe is thoroughly cleaned in the same way.

In the case of a wood coach where the repainting is to be complete, the next operation is to burn off all of the old paint, and in the case of a steel coach, the old paint is removed by sandblasting. While the car is on the pit the underframe is painted by the spraying process. The depth of the pit is such that a man may stand erect under a car and he can reach all of the ordinarily inaccessible places between the center sills, around the bolsters and in the corners with the spray so that all the parts of the underframe are completely protected against rust.

The car is now taken into the shop and placed in the working bay where it remains until the repair work and final painting is completed. In the meantime the seats, window curtains, etc., have been taken to the upholstery department for cleaning and repairing; the windows, screens, doors and other trimmings have been removed to the cabinet shop where the fittings are removed and sent to the plating shop for inspection and repair. The underframe and superstructure are ready for the steel and carpenter gangs. The batteries have been removed to the electrical shop for inspection, repair and recharging and the generators and regulators have been inspected and, if necessary, overhauled.

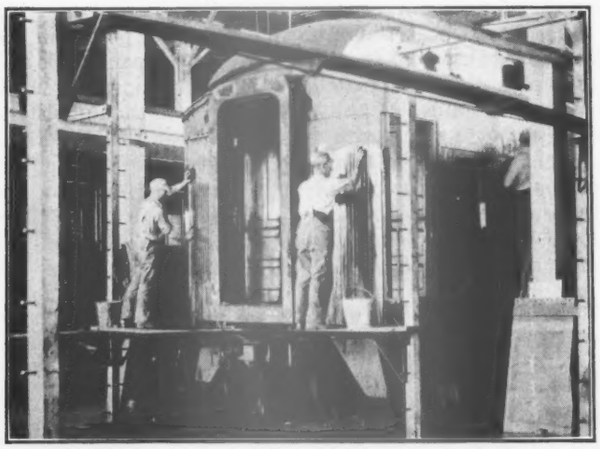
In the upholstery shop each seat and back are inspected and minor rips are sewed up. If the inspection shows them to require recovering, this is done. Seats

The varnish room showing the racks for drying and the stencil-cutting tables

Another view of the varnish room where the trimmings are washed

that do not require recovering are washed or cleaned, the cushions being cleaned on a table in which a revolving brush is mounted. The upholstery shop also cleans and renews window shades and makes and repairs vestibule curtains. Where a seat or back needs renewing it is stripped down to the frame and repairs made in the cabinet shop after which the seat or back is built up again using the same set of springs, reclaimed stuffing with entirely new covering material.

In the cabinet shop the doors, windows, screens or other wood trimmings are thoroughly inspected in sets

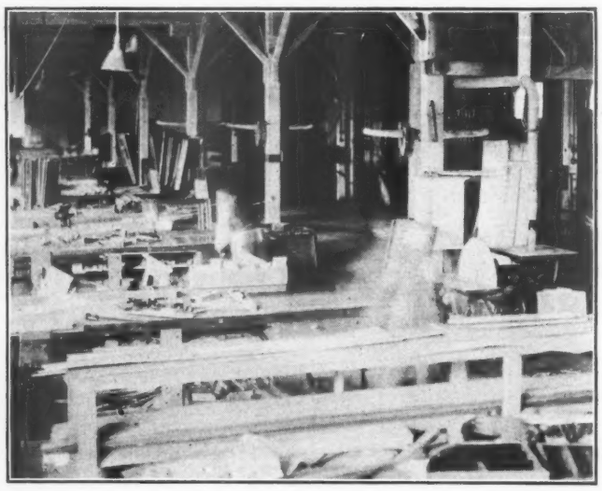


Rubbing down a wood car preparatory to refinishing

and the fixtures removed and sent to the plating shop. The wood parts are repaired where wear or deterioration necessitates and the bare trimmings are then sent to the varnish room. In the varnish room the first operation is to wash the parts in a large wash tank with soap and water, and anything that will not come off by this process is removed with soap, powdered pumice and water. While the various operations are being performed the parts for each car are kept together on portable trucks or racks. After washing, the trimmings are dried and are ready for refinishing. Where new material has been inserted in the repair work the

The upholstery shop

wood is sanded down and a coat of color applied and set aside to dry. Where the refinishing is over the original color the surface is given a light sanding and the varnish applied by brushing (the spray is not used for finishing work in this shop). On the sash refinishing tables the sash are laid on two supports with concave curved surfaces so that only a very small point of contact exists between the support and the varnished



The cabinet shop

surface. After the sash or door has been varnished it is put in an adjustable rack to dry. The edges of the sash supports in the rack are beveled to keep from marring the varnished surface. In this varnish room there are also two men who cut all of the stencils used on the road.

After the brass fittings have been removed in the cabinet shop they are placed in a box and sent to the

The paint store room.—The mixing room may be seen through the door

plating room. This shop is equipped with buffing machines, dryer, washing vats, oxydizing and plating vats. All of the brass fittings have an oxydized finish. After they are inspected and, if necessary repaired, they are boiled in a lye solution, dipped in acid solution, rinsed and then oxydized. They are then dried and polished.

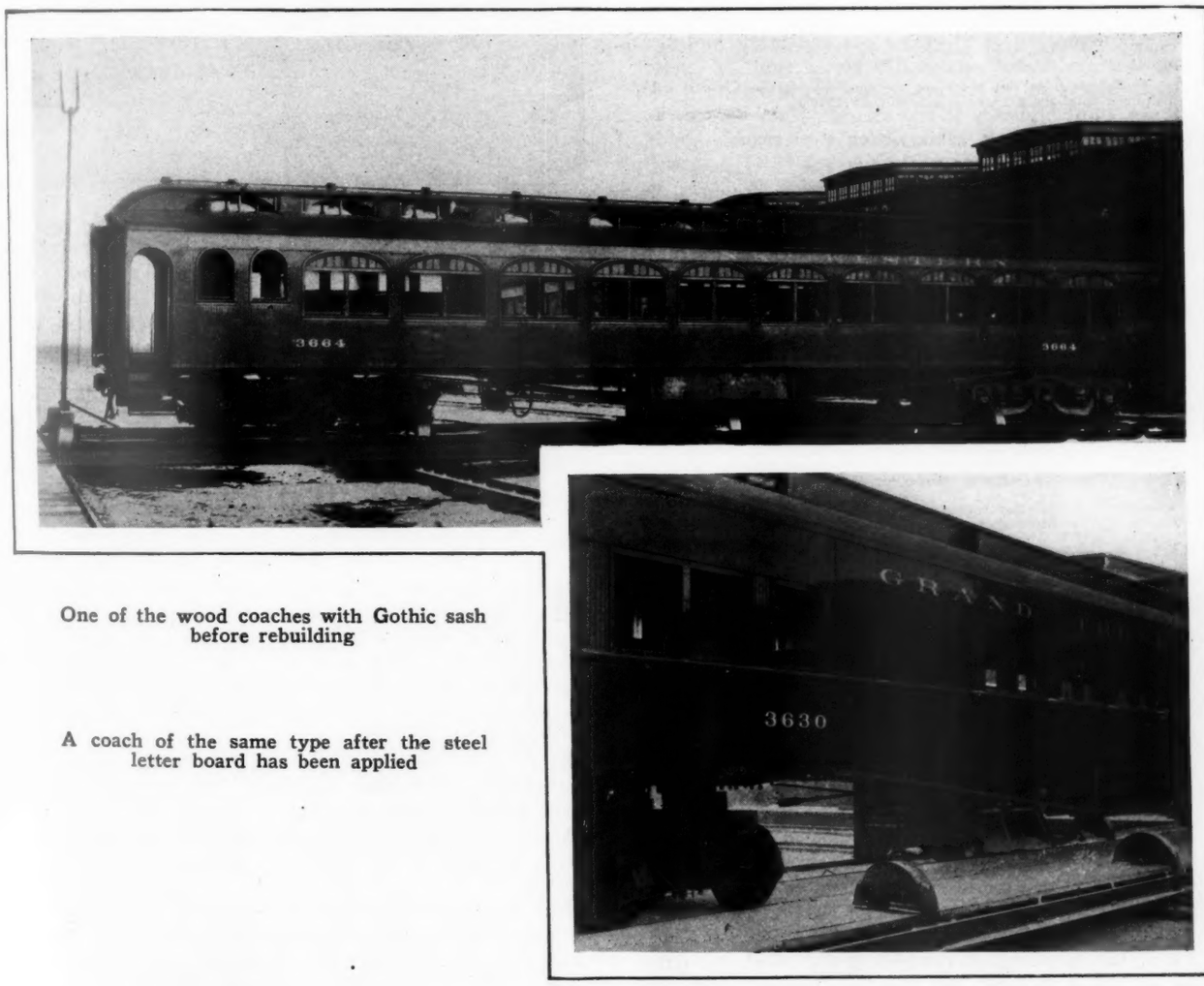
After the trimmings have been completed in the varnish shop and the fixtures completed in the plating room both are returned to the cabinet shop where the fixtures are re-applied.

A special job

At the present time there are a number of wood

coaches going through the shop that were originally built with Gothic sash lights at the top of the window panels. Owing to the curved outlines of the openings, these cars have presented an expensive maintenance problem and it was decided to change the structure of the exterior. The original construction of the car side had a letter board of wood 2 in. by 11 in. which was gained into the side posts to a depth of 5/8 in. below the plate, the bottom of the letter board touching the top of the curved opening for the Gothic sash. When the cars are rebuilt a 2-in. by 10-in. wood member is gained into the side posts below the original letter board so that it entirely covers the part originally shaped for the Gothic sash. This provides a wood surface 21 in. in depth above the window openings, over which is placed a steel letter board of No. 10 plate extending the full length of the car. This is fastened to the wood runner and side posts by No. 20 round head wood screws spaced on 3½-in. centers. The finished job presents the appearance of a more modern car in addition to materially strengthening the car as a whole.

A feature of interest in connection with the painting work at Port Huron is the separate paint stores and mixing room which is located at a distance from the coach shop, so that all of the paints and oils are isolated from any other building. The mixing room is a brick structure of two rooms, one used for mixing and the other for stores and distribution of painting materials. Two men are employed in this shop to prepare all the materials required by the coach painters for any particular job. When the painters are ready to go to work on a car they go to the paint store room and there they will find all of the materials needed for that job ready to take away with them. At the completion of the day's work all painting materials are returned to the store room where the brushes are cleaned, paint pails cleaned and returned to the shelf ready for the next day.



One of the wood coaches with Gothic sash before rebuilding

A coach of the same type after the steel letter board has been applied

The painting operations

All of the finishing work of passenger cars is a paint and varnish job applied by means of the brush. The cars are painted on the same track in the coach shop where they are placed for repairing. The different paint jobs are classified as to interior and exterior work.

The painting classification

Class	Interior work	Exterior work
A	New paint and varnish over new wood or steel	New paint job over new wood or steel
B	New paint over old surface	New paint over surface where old paint has been removed by burning off or sandblasting
C	Interior repainted, head-linings refinished, and revarnished	Stripped and scrubbed with soap solution and pumice; recolored and relettered with new gold
D	Interior washed and renovated; floors repainted; wainscoting and toilets revarnished	Lettering on exterior in good condition; cut around with color and revarnished
E	Interior washed and renovated and floors repainted	Exterior scrubbed and touched up. One coat of varnish applied.
F	Interior washed and renovated if necessary	Exterior cleaned and renovated only

Painting schedules

The classification of painting work is shown in tabular form. Some of the following painting schedules will be of interest as an indication of the time required on different classes of cars to complete the works of different classes of paint jobs.

Class A paint job on wood coach

Day	Operation
First	One coat of primer
Second	Allowed for drying
Third	One coat of surfacer
Fourth	Second coat of surfacer
Fifth	Putty and glaze
Sixth	Third coat of surfacer
Seventh	Apply guide coat for rubbing down
Eighth	Rub down with wet sandpaper
Ninth	Sand and apply semi-gloss color coat
Tenth	Apply coat of varnish color
Eleventh	Apply lettering and one coat varnish
Twelfth	Dry
Thirteenth	Final coat of varnish

Class B paint job on wood coach

Day	Operation
First	Burn off old paint
Second	Burn off old paint
Third	One coat primer
Fourth	Allowed for drying

(The operations from this point are the same as for the Class A schedule, making a total for a Class B schedule 15 days.)

Class A or B paint job on steel coach

Day	Operation
First	Sandblast and apply one coat of primer
Second	Allowed for drying
Third	One coat of surfacer
Fourth	One coat of surfacer
Fifth	Putty and glaze
Sixth	Rub down
Seventh	Light sanding and application of first color coat
Eighth	One coat of color varnish
Ninth	Letter and varnish
Tenth	Allowed for drying
Eleventh	Final coat of varnish

Class C paint job on steel coach

Day	Operation
First	Scrub with soap and pumice
Second	Scrape bad spots and touch up with primer
Third	Touch up with surfacer and putty
Fourth	Sand and spot or apply first color coat
Fifth	One coat of varnish color
Sixth	Letter and varnish
Seventh	Allowed for drying
Eighth	Final coat of varnish

Class A or B paint job on steel mail car

Day	Operation
First	Sandblast and apply primer
Second	Allowed for drying
Third	One coat of surfacer
Fourth	Second coat of surfacer
Fifth	Putty and glaze
Sixth	Sand and apply color coat
Seventh	One coat oil enamel
Eighth	Letter with imitation gold
Ninth	One coat of varnish

Class C paint job on steel mail car

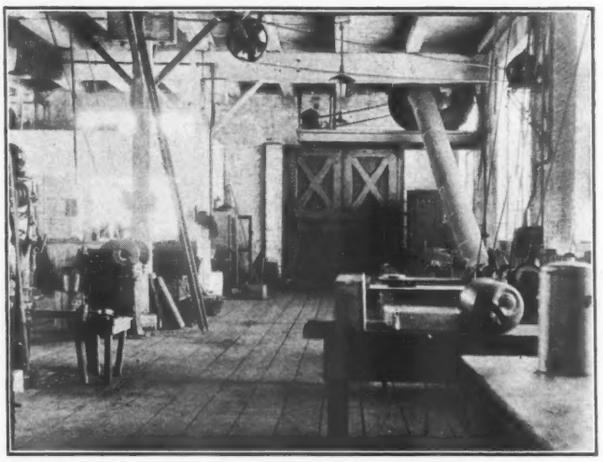
Day	Operation
First	Scrub
Second	Scrape and touch up
Third	Touch up with surfacer and putty
Fourth	Sand and apply one coat of color
Fifth	One coat of oil enamel
Sixth	Letter with imitation gold
Seventh	Apply one coat of varnish

The final operations

After the painting is completed the work of trimming the car is started. By this time the air brake and pipe work has been completed, the wiring and electrical equipment has been returned from the repair shop and re-applied, and the car has been raised and the regular trucks from the truck repair shop are placed under the car and the brake rigging coupled up and the brake equipment inspected and tested. The trimmings are then put in place and the seats installed.

While the cars are yet in the shop the electrical equipment is given a shop test that stimulates road operating conditions. A portable test set consisting of a motor with proper resistances for controlling the speed are mounted underneath the car and the motor is belted to the generator on the car. By experiment the proper speed has been determined and the car generator is operated at speeds corresponding to train speeds while the regulators are set to cut in and charge the batteries at the proper charging rate.

After all of the work in the shop has been completed



The plating room

the car is moved out of the shop and placed on the inspection pit previously mentioned where it is connected up to the steam lines and left under steam for several hours in order that all equipment may be placed in working order and any leak repaired. After the final inspection the car is ready to leave the shop and return to service.

Passenger and freight car repair classification*

MORE definite classifications are needed as a check on both the quality and quantity of shop output. Any general means of classification of freight cars, showing the class of repairs which is required to restore it to service is satisfactory, to some extent. The system, however, which is the simplest to understand is by far the best classification.

There are three classes of repairs: Running repairs, light repairs, and heavy repairs. These three classes can be sub-divided if desired.

A very excellent classification method for freight car repairs is used by the Baltimore & Ohio, which is as follows:

Running repairs are known as class D and represent one man-hour and less than two man-hours for labor.

Light repairs are sub-divided into two classifications: Class C for two man-hours and less than ten for labor and C-1 for 10 man-hours and less than 20 for labor.

Heavy repairs are sub-divided into five classes: Class B representing 20 man-hours and less than 40 man-hours for labor; class B-1 40 man-hours and less than 60 man-hours for labor; class B-2 60 man-hours and less than 80 man-hours for labor; class B-3 80 man-hours and less than 100 man-hours for labor; class B-4 100 man-hours and over.

* An abstract of a report to the International Railway General Foremen's Association at its convention in Chicago, September 18 to 21, 1928, by a committee of which A. H. Keys, general foreman, Baltimore & Ohio at Cumberland, Md., was chairman.

The hours of labor for classification purposes include only the actual car-repair labor in applying the various parts to the cars. Saw mill, machine shop, blacksmith shop, and other shop labor or supervising expense is not included in the figures used in the classification of repairs. The labor consumed in all the blacksmith shops, saw mills, drill shops, etc., located on the car-repair tracks, which are used to facilitate the work, is included in hours of labor to designate the class of repairs made.

In order to facilitate the prompt movement of cars from the shop they should be classified into three distinct groups:

(a)—Heavy classified repairs and rebuilding, such as Classes B, B-1, B-2, B-3 and B-4 and which represent such class of repairs that can be made in not to exceed six eight-hour days.

(b)—Cars in need of light repairs such as Classes C and C-1, and which are such classes of repairs that can be made in not to exceed three eight-hour days.

(c)—When in need of running repairs such as Class D, and which can be made in not to exceed one eight-hour day.

By grouping the repair classification as above, assurance is given of the prompt movement of the car from the shop.

Repairs to freight car equipment requiring less than one hour for labor will not be considered as classified repairs, but will be considered only as inspection repairs.

Passenger car repair classification

A monthly passenger car shopping program is furnished each passenger car shop, and those responsible for the maintenance. This list provides sufficient cars to meet the shopping requirements of the shops where the work is done, cars to be sent in as the repaired cars are restored to service. A copy of this statement is furnished the general superintendent of transportation, who is requested to have the cars moved to the shop for repairs as required.

The classification of passenger car repairs is divided into five groups as follows:

Class 1 repairs—General repairs to roof, vestibules, platforms, trucks, upholstering, hardware, lighting equipment and to interior and exterior. Burning off, repainting and revarnishing exterior and woodwork, finishing or scraping off old woodwork as required, and refinishing the interior.

Class 2 repairs—General repairs to roof, vestibules, platforms, trucks, upholstering, hardware, lighting equipment and to the interior and exterior, repainting without burning off old paint or applying new lettering or decoration and revarnishing exterior. Scraping as required and revarnishing all parts in the interior.

Class 3 repairs—General repairs to roof, vestibules, platforms, trucks, upholstering, hardware, lighting equipment and to the interior and exterior. Cleaning down and touching up, revarnishing exterior, scraping as required, varnishing in part and renovating the interior.

Class 4 repairs—Light repairs and alterations to cars that have been out of shop less than 10 months since receiving Class 1, 2, or 3 repairs, made on account of accident. Cleaning without repainting or revarnishing exterior and renovating the interior.

Running repairs—General tightening up, application of couplers, wheels, journal boxes, steps, brake beams, platform sills, safety appliances, etc., and light repairs to interior and exterior when labor cost is less than $50.

Classes 1, 2, or 3 repairs should produce at least 12 months' continuous service to the car before it again requires classified repairs. When cars are sent to the shop, especially for accident repairs, but receive classified repairs at the same time, the word "Accident" must be shown as a prefix to the figure, indicating the class of repairs made. All repairs will be classified by the work done on the exterior of the car.

The program for shopping of passenger cars by class is governed by the number of months of service which the car has had since the last shopping or class repairs were received. The cars being out of shop the greatest number of months are the ones which are put through shop for classified repairs. In this manner the shops are better able to take care of certain classes of equipment at or about the same time and establish more efficiency than by collecting cars at random and mixing the different types or classes of repairs.

Conclusion

Too much cannot be said as regards the proper classification of repairs for freight and passenger car equipment, as there is no other one thing that will disrupt the proper and efficient organization of a shop than that of mixing class repairs. The classifications as shown above are those which have been in effect on the Baltimore & Ohio for a number of years and are the result of years of experiment along the lines of proper classification of freight and passenger equipment and when worked according to instructions prove satisfactory.

A convenient method of carrying nuts and washers

A WIDE assortment of nuts and washers is needed in car repair work. They are often difficult to obtain, especially on the rip track. The nut and washer carrier, shown in the illustration, saves the workmen much time as they can carry an assortment of nuts and washers with them.

The base of the carrier is made from a 10-in. by 12-in. by 1½-in. board. It is reinforced by boring two holes through the board from edge to edge near each end and drawing up a ½-in. bolt in each hole. A number of small holes are then bored through the board and 10-in. sections of ½-in. rod inserted and held in a vertical position by two nuts, one on the top and the other on the bottom of the board. The board is carried by a rod with a loop in the upper end.

A convenient board for carrying nuts and washers in the car repair yard

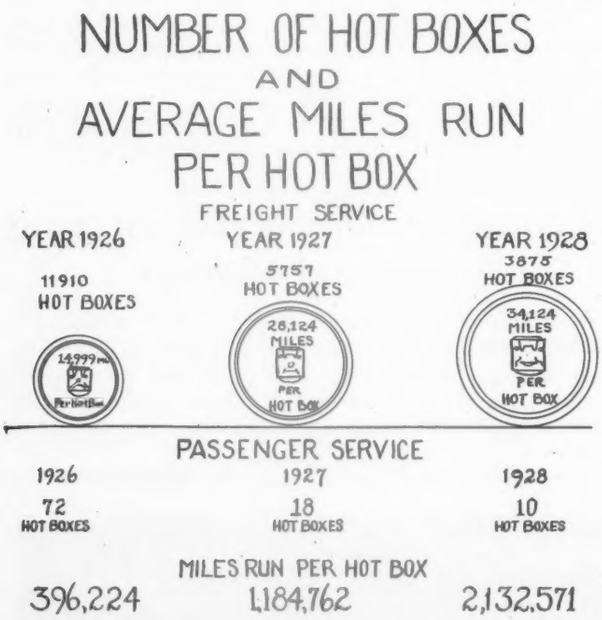
Making statistics interesting

Charts and cartoons make an impression on the memory which figures alone can not do

THE all-around foreman, one who has grown up from the ranks, is still typical, especially in the smaller shops and at outlying car repair points. His duties are many. He is expected to fix costs, supervise machine tool installations and repairs, hire men, keep records, inspect work, train new employees, advise and suggest changes in handling the work and, at the same time, obtain the required output.

Foreman deserves help from the management

The average car or locomotive shop foreman has plenty to do. He has usually left school at the completion of the grammar grades and there is no one who is so confident in his own knowledge as the self-made man. Frequently, the greatest obstacle to changes and improvements comes more from foremen rather than from either department heads or from manual workers.



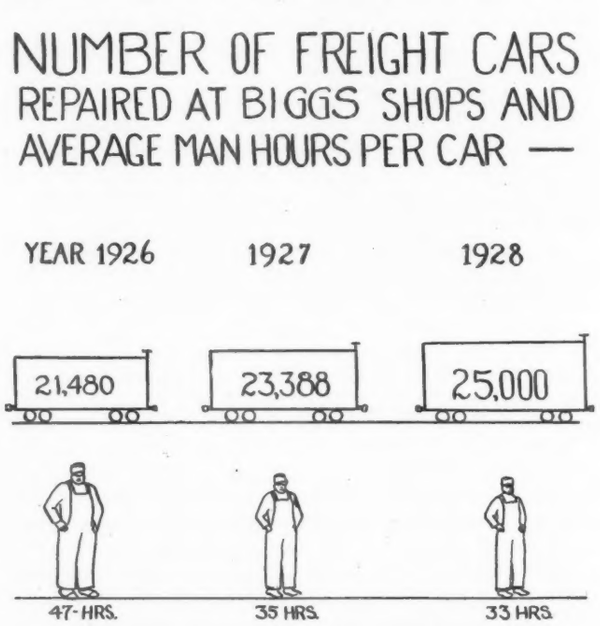
A good hot box record puts a smile on the face of the journal box

There is also a strong element of accumulated fatigue of body and mind that may affect the foreman's outlook. It is only by dint of hard work over long hours, with generous donations of overtime, that his advance has been made. He is often the first man in his shop in the morning and the last to leave it at night. Add to this the fact that too many, and too diverse duties are often placed on him, and it is not strange that some foremen are chronically tired out.

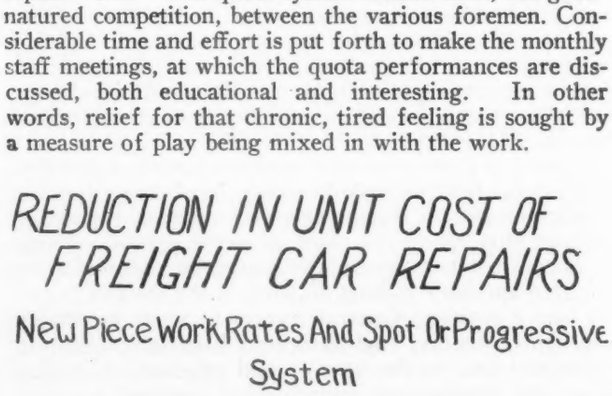
How one car department head helps his foremen

Recognition of these conditions of the foreman's job is an important feature in efficient management. One car department head has been active during the past few years in helping his foremen in every way possible. He has recognized the fact that there are certain fundamental characteristics of human nature that must be taken into account and that can be used to advantage in car repair work.

One of the schemes he has introduced effectively is the adoption of a system of quotas for important items of car repair work. The quota system creates keen, but good-natured competition, between the various foremen. Considerable time and effort is put forth to make the monthly staff meetings, at which the quota performances are discussed, both educational and interesting. In other words, relief for that chronic, tired feeling is sought by a measure of play being mixed in with the work.



Biggs is watching Tannersville

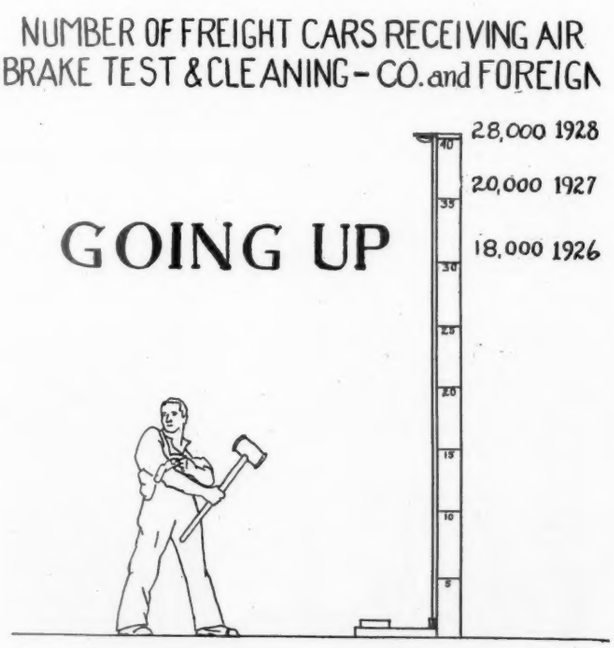


The new vs. the old

Minutes of these staff meetings are prepared, and mimeographed copies are sent to all concerned, which includes all foremen and assistants in the car department. Examination of a year's file of these minutes reveals that a large portion of the mimeographed pages are devoted to figures on repacked journal boxes, freight and passenger car-miles per hot box, number of freight cars reweighed, freight train detentions due to car defects, cars receiving air brake attention, etc. The budget figures, together with the amounts spent and to be expended, chargeable to accounts 314, freight train repairs; 317, passenger train repairs, and 326, work equipment repairs, are all shown in the minutes, together with the discussion that took place at the meeting relative to these accounts.

Difficulty of remembering figures

Men do not readily remember figures. It is hard to keep in mind the comparison of this year's performance



Getting ready to "ring the bell" for 1928

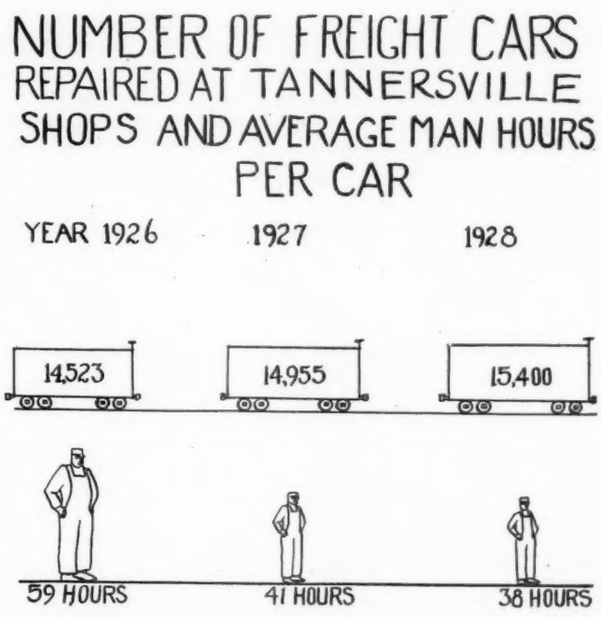
with a corresponding month of last year, for even that does not always give a reliable comparison of real efficiency. However, much good can be accomplished from a consideration of expenditures if a proper perspective is used.

Hardly a week goes by but that the superintendent of the car department is not called upon to explain high costs. He must know the reason for high costs as well as the reason for low costs, so that he can be on the alert to regulate his forces and production to suit the traffic being handled and the company's finances.

Each foreman contributes a part of the data and information that goes to make the complete picture. But few, at least on a great many roads, ever get to see the picture after it has been completed. Undoubtedly, the foreman would be in a better position to help if he knew more about what was going on and could see some of the department head's problems.

Pictures or cartoons are easy to remember

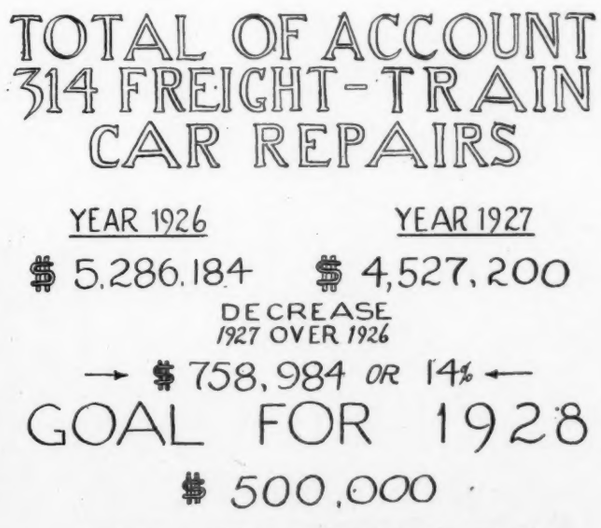
During the past few years, the superintendent of the car department of the railroad referred to has been attempting to keep his department interested in management problems by the use of slogans of an inspirational



And likewise Tannersville has its eyes on Biggs

nature. These slogans were, and still are, incorporated in the minutes of the monthly staff meetings. However, in addition to the monthly staff meetings, the mechanical department, both car and locomotive, holds an annual meeting of its foremen, which is largely of an inspirational nature.

The superintendent of the car department was asked



Quotas are set for accounts 314, 317 and 326

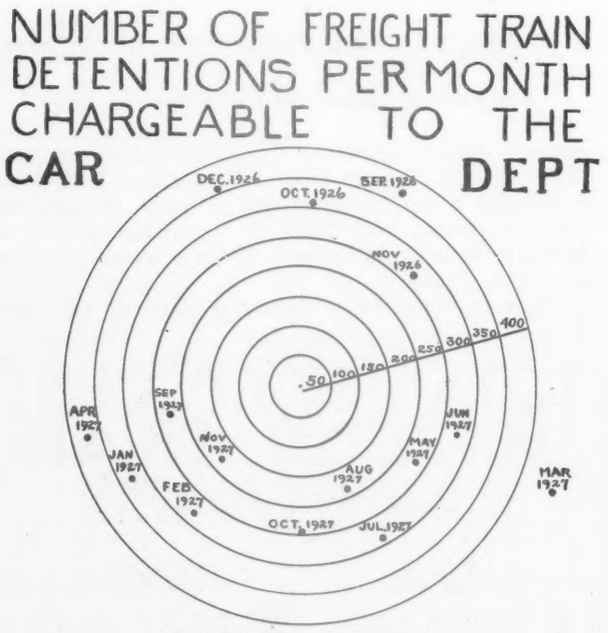
to give a talk at the last annual meeting. This gave him the opportunity he needed to present, not only to his own staff, but to every one else concerned, what the car department was doing in the way of actual accomplishment. He realized that to read a lot of figures would not get the results he desired and, besides, would give the impression of boasting.

Instead, he prepared the cartoons shown in the vari-

ous illustrations and had lantern slide reproductions made to show as he gave his talk. The eight cartoons shown are selected from a total of 20 or more which made up the complete group. Each slide showed figures, in an interesting and attractive way, on some item that the management considered important in administering the affairs of the car department. It not only secured the attention of each foreman to these important items, but it also impressed on his mind the need of exercising good judgment in handling and supervising his work in order to keep down repair costs and, at the same time. do a quality job. Taking the series of slides as a whole, no loyal foreman or supervisory officer could help but feel proud of the fact that his department was able to turn over to his company a check for $758,984 and want to do better next year.

Knowledge of the business side tends to increase efficiency

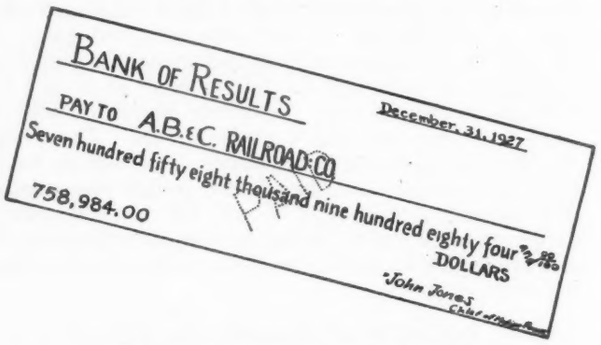
It has been found that greater knowledge of the maintenance of equipment accounts, or knowledge of the business side of the work, has resulted in more efficient supervision. During trips over the road, the executive



A bulls-eye to shoot at

officer, car department head or his assistant, frequently asks the question: "How did expenses last month compare with the corresponding month of other years, or with the highest or lowest of any year?" or "What are the man-hours per freight car last month as compared to the month preceding?" Very few men can answer such questions, but on this road the information is frequently volunteered. Any one can work it up, and a supervisory officer should know in a general way the answers to such questions if he is really ahead of his job. He possibly might keep these in a notebook, but an officer who asks such questions does not want to wait for his answer until a notebook can be consulted.

After all, what has been said in the preceding paragraphs does not apply entirely to the foreman. Some department heads do not use the statistics they have in their own offices. Things are going on in their departments that result in wastes of labor and material of which they know nothing. Making "pictures" or charts of such information is a good way of remembering. The moral

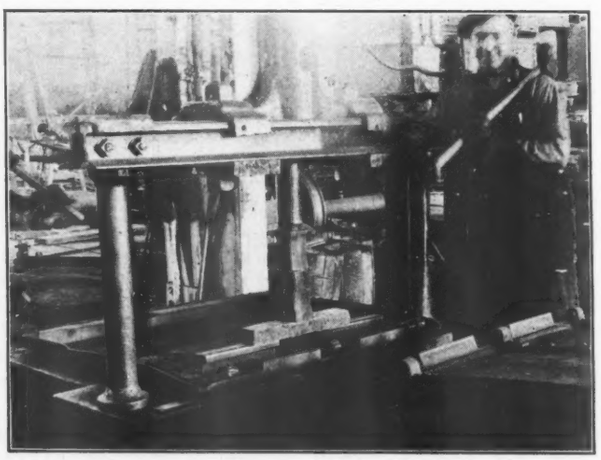


The car department earns dividends

of this story is this: When you have data and statistical information available in your office, first digest it and then find a way to make use of it.

Press for straightening hopper car doors

THE hydraulic press, shown in the illustration, enables two men quickly to straighten steel hopper car doors. The metal base of the press is a little larger than the doors. A 4-in. steel post, 3 ft. high, is mounted at



A hydraulic press used for straightening hopper car doors

each end of the base. On top of these posts are bolted the two sections of rail, slightly bowed in the middle, which form the top of the frame. A heavy hydraulic jack with a 4-in. plunger is inverted on top of the rails and held firmly by two sets of heavy clamps and bolts. Salt water, pumped from a tank on top of the frame located near the end, is used as a pressure medium. The water is forced into the jack by an air-driven pump fastened to the end of the frame. Two pipes connect the tank with the jack, one for the entry of the liquid, the other for its return.

Various sizes of blocking are kept on hand and two different bulges can be straightened in one operation as shown in the illustration. Sledges are used occasionally to aid the jack in straightening exceptionally deep bulges. The air pump is just behind the man at the right.

Union Pacific buys long coaches

Fifteen 83-ft. cars combine attractive decoration with latest modern conveniences—Sashless windows

THE Union Pacific recently received from the Pullman Car & Manufacturing Corporation 15 modern all-steel coaches, featured by unusual length, and attractive interior decoration and equipment designed to provide the maximum of comfort and convenience for passengers.

Since these cars have been received, their riding qualities, etc., have been carefully observed. It is reported that they ride remarkably well, and are unusually free from the transfer of objectionable noise to the interior of the car. The superior riding qualities are attributed to the long wheel base, the cars being of the same length as the standard Pullmans, also to the use of six-wheel trucks combined with proper spring equipment. The sound-deadening effect is obtained by the use of a sheet rubber mat covering the entire floor, and also by the double plate-glass window arrangement in which the glass is supported in felt runways, thereby eliminating vibration and rattle.

The last lot of coaches built for the Union Pacific weighed 145,000 lb., and the new coaches, which are 3 ft. 8 in. longer, weigh only 146,800 lb., in spite of the fact that heavier seats are used, as well as the rubber floor mat. This reduction in weight was accomplished by using a superstructure of pressed steel members instead of rolled shapes. The pressed steel members are heavily coated with car cement in order to guard against corrosion.

The new Union Pacific coach is 82 ft. 11½ in. long over the buffers, being one of the longest passenger coaches ever built. It is constructed of steel throughout, including the interior finish. The roof is of the clerestory type. End vestibules are provided, equipped with modern trap doors, diaphragms, curtains, etc.

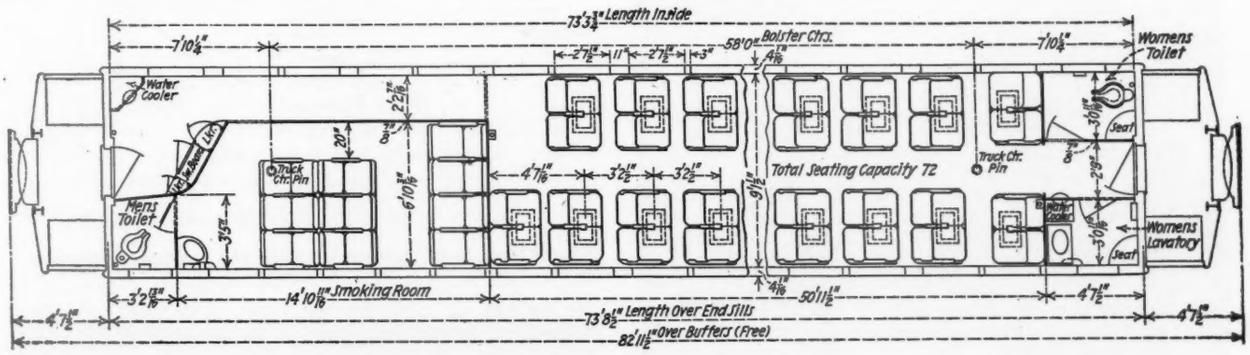
The trucks are of the 6-wheel type, having Commonwealth cast steel frames, Simplex clasp brakes and rolled steel wheels. The latest Westinghouse air brake and signal quipment is provided, every precaution being taken, both in design and construction of the car, to assure the safety of the passengers.

The car has a total seating capacity of 72. The main compartment, which is about 51 ft. long, has a seating capacity of 62, and the smoking room, which is about 15 ft. long, has a seating capacity of 10. As indicated in the drawing, there is a women's lavatory equipped with a washstand, running water, mirror, towel cabinet and a small seat, also a women's toilet equipped with a flush water closet, toilet paper holder and a small seat. These facilities are located at the opposite end of the car from the smoking room.

Adjacent to the smoking room there is provided a men's toilet with a flush water closet and toilet paper holder, and directly outside of the toilet in the smoking room is located a washstand, towel cabinet and mirror. All of the washstands and hoppers are of solid porcelain, furnished, respectively, by the Standard Sanitary Manufacturing Company, Pittsburgh, Pa., and the Dayton Manufacturing Company, Dayton, Ohio. Disinfecting cans are provided in each toilet. Adjacent to the women's and men's wash basins are placed soiled towel receptacles.

Seats the most striking feature

In order to provide the maximum of comfort for passengers, particular attention has been paid to the seats and their arrangement, also to the provision of adequate heat, light and ventilation facilities.

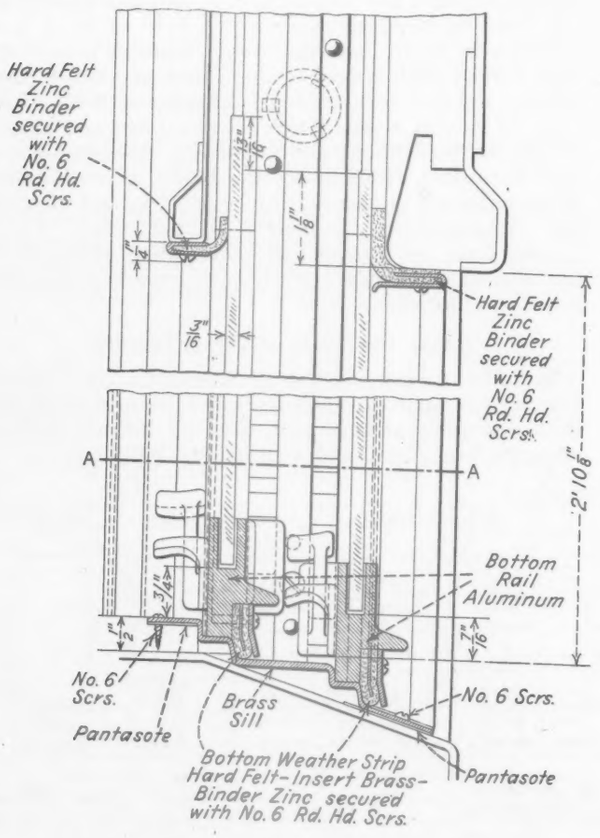


Floor plan of the Union Pacific coaches

Probably the most striking feature of the car is the seating arrangement and equipment. Seats in the main compartment are of the latest type, designed to rotate instead of being turned over when the direction of the car is changed. They are unusually comfortable and handsomely upholstered in a high grade blue frieze plush which harmonizes with the general color scheme of the car. Ample space has been provided between the chairs which should add to the comfort of the occupants. Ordinarily each seat is intended for the accommodation of two people, but by dropping the center arm the seat is made continuous, thus affording a more flexible seating arrangement. On the back of each seat is placed a metal drop coat rack. The backs of the seats are of the double-bucket design with soft upholstering and with a well-defined division between the two seats. Two individual air spring cushion pads are placed separately on top of an auxiliary spring cushion, thus forming a deep cushion similar to that found in the best of house furniture. Well-upholstered arm rests are provided at each end of the seat. The seats are conveniently reversed by tripping a release device located on the outside of the steel base.

The seats or sofas in the smoking room are of the same general design as those used in the main compartment. However, they are made up in groups and do not rotate. They are heavily cushioned throughout and are upholstered in real leather of a brown shade to harmonize with the color scheme of the compartment. Three car sets of seats were furnished by the Heywood-Wakefield Company, Chicago, and 12 car sets by the Hale & Kilburn Company, Philadelphia, Pa.

The heating apparatus employed is of the latest type, developed by the Vapor Car Heating Company, Chicago. Automatic thermostat control is provided to assure proper temperature regulation. The floor, walls and roof of the car are heavily insulated.


Hard Felt Zinc Binder secured with No. 6 Rd. Hd. Scrs.
Hard Felt Zinc Binder secured with No. 6 Rd. Hd. Scrs.
A
A
2'10⅛"
Bottom Rail Aluminum
No. 6 Scrs.
Brass Sill
Pantasote
No. 6 Scrs.
Pantasote
Bottom Weather Strip Hard Felt-Insert Brass-Binder Zinc secured with No. 6 Rd. Hd. Scrs.

Vertical section through the sashless window

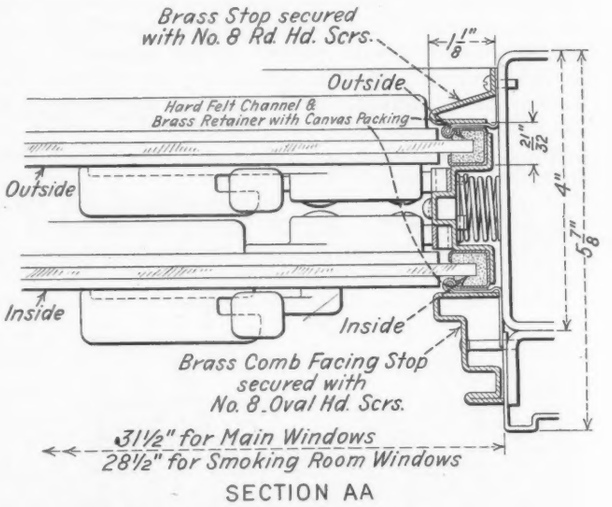
Careful attention has been given to the lighting of the car, and in order to provide a thoroughly diffused light, fixtures of the semi-indirect type are employed. Manufactured by the Safety Car Heating & Lighting Company, Chicago, the fixtures are arranged as follows: Each car has eight center fixtures with large opal bowls, six fixtures lighting the main portion of the car and two, the smoking room. There are four lower deck lamps with Pearla bowls, two in the passageway and one at either inside vestibule. The lavatories and washrooms are lighted by one-light bracket lamps with radiant glass shades, one also being used in the smoking room. The platform vestibules are lighted by two vestibule lamps at each end of the car.

The lighting generators, also made by the Safety Car Heating & Lighting Company, are of 4-kw. capacity and of the drawn-steel magnet-frame type. The battery current and lamp voltage are controlled by the latest type regulators. The switchboards are the Union Pacific standard 6-circuit type. The storage batteries are manufactured and furnished by the Edison Storage Battery Company.

Ventilation—Sashless windows

Proper ventilation is secured by 14 Utility induced draft ventilators, located on the sides of the clerestory of the roof. Two 27-in. electric-driven paddle deck fans are provided in the main compartment and one in the smoking room, which will assure ample circulation of the air and thus add to the comfort of the passengers.

Another attractive and novel feature of these cars is a new type of window construction, in which the ordinary wooden sashes are replaced by sashless windows operating in belt runways, as furnished by the National Lock Washer Company, Newark, N. J. The outside and inside panes of 3/16-in. polished plate glass are mounted in aluminum rails at the bottom in a similar manner used in connection with automobile windows by means of cork rubber tape. On this rail are attached the locks and lifts. On the outside of the rail is fastened a bottom felt weatherstripping arrangement, which, with the bottom sill-piece, forms a weather-proof construction. At the window header there is fastened metal-bound felt weatherstripping so arranged as to impinge tightly against the window panes at all times.



Horizontal section through the sashless window

The side construction consists of outside, center and inside metal stops. The center stop carries the metal-encased felt channels in which the glass tracks. This stop is flexibly mounted by three coil springs on each side which holds the felt runways constantly in close contact with the plate glass. It will also be noted that the center stop carries the lock racks, which arrangement provides for maintaining the proper relation between the lock and rack.

The metal channels enclosing the felt runways each have mounted on one leg water-proof canvas which is carried underneath the inside and outside stops respectively, thus preventing water and dust working under the stops into the inside of the car. The center stop is flexibly fastened at the bottom and extends beyond the header in order to provide support for the glass when raised.

This construction is weather, dust, and rattle-proof, and provides thorough insulation, thereby preventing the entrance of cold from the outside and heat from the inside to the outside through the various parts. These

are desirable features which have been substantiated by some windows of this type which the Union Pacific has had in service for about fifteen months in an older car.

Another important feature is the flexibility of the entire window construction which allows for the weaving and twisting of the car without binding or breaking any of the window parts. This flexibility in the construc-

View showing attractive interior decoration and revolving double bucket type seats

tion takes care of the usual variation in the size of the window opening, and it has been proved, that the glass cannot stick within the felt runways under any operating conditions.

Four-tone color scheme employed

As great variety of color is now being extensively used for decorating purposes, it was decided not to use

Close-up view showing window details of new Union Pacific coach

the mahogany interior finish formerly employed in Union Pacific car equipment, and which was somewhat sombre, but to provide a lighter and more cheerful four-tone color scheme.

The interior of the new coaches is finished throughout in a symphony of browns and tans, starting with a deep shade of brown for the heater pipe grilles. Between the grill and the window sill is a somewhat lighter shade of brown. The window piers and the paneling over the windows are of the same base color, but of much less strength. The ceiling and lower deck panels are finished in a cream color.

The decorations of the side walls are dependent upon the good proportions and harmonious relations of their parts for its major scheme. However, the wall colors are enlivened by a recall of the blue upholstering and its complement of rose, for defining the paneling, and the ceiling and lower decks are properly emphasized by simple line decorations.

The window shades were especially produced to further bring out the symphony of browns but with the recall of blue in order to be in strict co-ordination with the balance of the car. The hardware throughout the car, including window and curtain fixtures, seat trim-

Sashless windows are installed; Seat backs have metal drop coat racks

mings, door trimmings, etc., are all finished in a silver effect and harmonize with and enhance the blue upholstering. The upholstering on the seats in the main compartment is frieze mohair of true blue, of a pleasing intensity, over which is a festoon design.

A distinctive feature of the car is the use of polished black Bakelite for the window sills which not only adds a modern touch to the color scheme, but provides a material with good service value in that it retains its color and is not readily scratched or discolored. The hopper seats and covers are of ebony finish. The interior doors are of mahogany, stained brown, with narrow inner panel lines of cream color.

Heavy sheet rubber tiling, furnished by the United States Rubber Company, Chicago, covers the entire floor of the car. This covering is laid in 5-in. alternating diagonal blocks of mottled black and golden-brown and mottled blue, golden-brown and white. The rubber tiling not only provides a well-cushioned footing, but also acts as an insulator and is an excellent sound-deadening material.

Decisions of the Arbitration Committee

(The Arbitration Committee of the A. R. A. Mechanical Division is called upon to render decisions on a large number of questions and controversies which are submitted from time to time. As these matters are of interest not only to railroad officers but also to car inspectors and others, the Railway Mechanical Engineer will print abstracts of decisions as rendered.)

Handling line held responsible for damage to a car caused by buckling of an adjacent car

On August 30, 1926, while a cut of twelve cars was being placed on the rear of a Chicago & Eastern Illinois train considerable damage was done to four of the cars, including Wabash Car No. 22494. The cars were cut loose from the engine on the hump and allowed to drift to the rear of the train, in charge of three riders. No damage was sustained by the first three cars coming in contact with the train, no cars were derailed, nor was there any other damage except to the four cars in question. All of the damage was the result of F.G.E.X. cars No. 15385, 40648 and 10225 being unable to absorb the shock of impact when the cut coupled to the standing cars. The damage to the Wabash car was brought about by car No. 10225, a bad-order car, buckling in the center in such a manner as to force the end of this car against and into the metal end of Wabash car No. 22494, bending the metal end inward and damaging the superstructure above the sill. The Wabash, therefore, maintained that the damage to its car was a handling line responsibility and should come under the responsibility of Item (o), Section D, of Rule 32 (telescoping superstructures above the sills due to the mounting of an adjacent car), or the damage could be charged to one of the conditions of irregular switching as covered by Rule 32, interpretation No. 8. The handling line maintained that the operation was a regular switching movement and that there had been no violations of the A.R.A. rules.

The Arbitration Committee stated that "The damage to the car in question, under the conditions described, is beyond the scope of owner's responsibility. The contention of the Wabash is sustained.—*Case No. 1568—Chicago & Eastern Illinois vs. Wabash.*

Owner held responsible for car damaged by train parting and throwing brakes into emergency

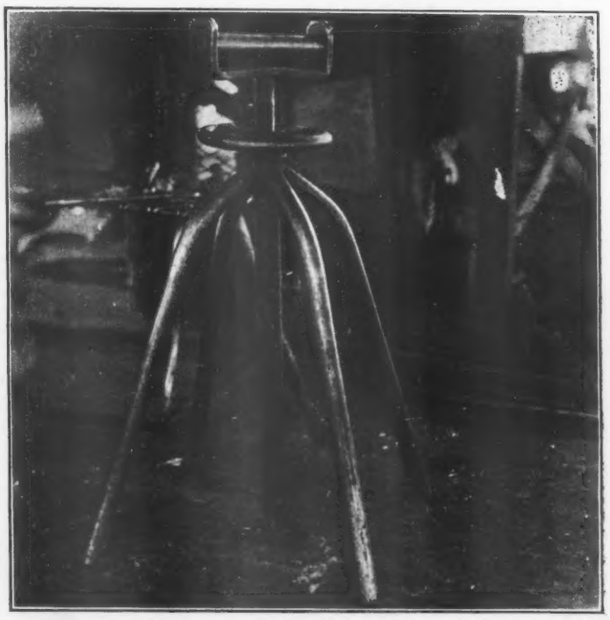
Indianapolis Abattoir Corporation car No. 54, of all wood construction, was damaged on January 21, 1923, while being handled on the Pennsylvania lines. In a train of 85 cars with two engines pulling and two pushing, the drawhead was pulled out of A.T. & S.F. stock car No. 55506, the sixteenth car in the train, due to the yoke breaking, causing the air brakes to go into emergency, resulting in car No. 54, the sixty-fifth car in the train, being damaged. There were no cars derailed. The owner requested that sufficient repairs be made to send the car to the home shop and took no exception to the responsibility. Upon arrival of the car at the home shop, the owner had a joint inspection made by representatives of three roads, with its own representative and a representative from the Pennsylvania present. After the inspection was made, the owner rendered a bill against the Pennsylvania for the depreciated value of the car, $2,064.24, plus the cost of repairs made by the Pennsylvania to send the car home, less credit for trucks and scrap, or $1,903.69 net. The Pennsylvania returned the bill, considering the defects to be the owner's responsibility as there was no unfair usage under Rule 32. The owner expressed the opinion that the case was purely a technical matter as it was not bound by A.R.A. rules, not being a member of the association. It felt that the car had been subjected to very unusual handling, and therefore, the damage was the handling line's responsibility.

In rendering its decision, the Arbitration Committee stated that "The car was damaged as the result of an emergency application of the air brakes, due to parting of the train. There is no evidence of unfair usage under Rule 32, therefore, the damage to this car is the owner's responsibility."—*Case No. 1570—Indianapolis Abattoir Corporation vs. Pennsylvania.*

A five-legged work horse

THE five-legged horse, shown in the illustration, is a valuable accessory for use in the steel car shop where they are used to support long sections of steel while passing them through the various machines. They are strong enough to support heavy material and yet can be easily moved about by one man.

The legs, of 1½-in. pipe, are welded together at the top. The fifth leg in the center does not quite touch the floor, as it is used only to steady the 1-in. screw bolt which regulates the height of the roller supporting the load. This metal roller is in a frame of ¾-in. by 2-in. steel and is fastened by riveting the frame to the screw bolt. An 8-in. wheel, through which the screw bolt passes, allows the load to be raised or lowered without removing from the horse. It can also be pulled forward or back, or turned around, without removing the load from the support.



A five-legged, adjustable work horse

Getting back to fundamentals

Chicago & Alton restores locomotive spring rigging and motion work to original blue-print dimensions

AFTER locomotives have passed through heavy repair shops several times, and received light repairs and possibly emergency repairs at outside points, it is not at all uncommon to find a considerable number of locomotive parts which, for one reason or another, do not check with their original dimensions and specifications. These variations from original blue-print dimensions, whether due to excessive wear, carelessness in shop practice, the carrying out of some outside foreman's unauthorized ideas, or possibly the forced use of non-standard substitute material, tend to promote unsafe, inefficient locomotive operation and excessive maintenance costs. Without incessant vigilance in the back shop, and also at engine terminals, experience has shown that these undesirable conditions are bound to creep in.

Close-up view showing gage details

Realizing this fact, the Chicago & Alton has, for the past twelve months particularly, been engaged in an active campaign to get back to fundamental dimensions of locomotive parts as specified on original blue-prints, and, already, gratifying results of this campaign begin to appear. All important details, such as cylinders, frames, wheels, driving boxes and motion work, are carefully checked, and, owing to the close tolerances allowed, the general standard of workmanship at the main shops at Bloomington, Ill., for example, has been substantially raised. Similarly, locomotive conditioning operations at enginehouses have been systematized and the making of non-uniform repairs discouraged. As a result, a considerable degree of standardization and interchangeability of parts has been secured, accompanied by reduced production costs and greater freedom from locomotive delays while waiting for specially-machined parts.

One of the best indications of the higher standard of maintenance operations on the Chicago & Alton is the improved condition of motive power, enabling

Method of using hook-type gage

more tonnage to be handled and in fact, the tonnage ratings of a number of classes of Chicago & Alton locomotives are now in the process of upward revisions. Another indication is the marked improvement in locomotive condition as regards federal defects. This is evidenced by the chart, reproduced, which shows a substantial decrease in locomotives found defective and in the number of those ordered out of service by the federal inspectors. While this decrease evidently began in 1923 and 1924 folowing the shopmen's strike, it has been particularly noticeable in the past year or more.

Repaired valve motion parts—Valve spools and bull rings are shown in the background

Spring rigging standards maintained

The work of getting back to fundamentals in spring rigging and valve motion parts, has received particular attention at the Bloomington shops. As regards spring rigging, one of the first points of attack was spring saddles which were found worn to varying degrees. This condition, combined with bearing pockets in the driving boxes out of square, caused tipping of the spring saddles, chafing of hangers against frames, improper spring equalization, low riding locomotives and numerous federal defects from these causes.

To overcome these difficulties, the following method of handling spring rigging at Bloomington shops was developed: After the spring rigging has been cleaned at the lye vat, the spring hangers are trucked to the blacksmith shop where they are inspected, annealed and repaired, being brought back to standard blue-print dimensions. The hangers then are sent to the machine shop where casehardened bushings are applied, giving a service life to the hangers equivalent to two or three general shoppings of the locomotive. The equalizers receive the same treatment, being checked for height and distance between pin poles, and receiving casehardened bushings.

Referring to the spring-rigging drawing, it will be noted that loop-type hangers are used wherever practicable, permitting the ready detection of defects, not always possible with other types of hangers. Moreover, this hanger is easily forged all in one piece, saving one pin and gib as well as one boss hanger. The loop hanger is strong, provides maximum spring flexibility and has a minimum of wearing parts to need refitting and replacement. Electric steel is used for hangers other than loop-type hangers.

The spring saddles are sent direct to the blacksmith shop where they are annealed, inspected and squared, then being moved to the machine shop, to the layer-out, who checks them for length and size. For example, if a saddle is 14 in. in height, as called for by the blue-print, a square line is scribed on the saddle 12 in. from the top on both sides. If the saddle will not true up to a line 2 in. below the square line (usually the case), the saddle is sent to the welder and built up the required amount by the oxyacetylene process. By having the square line as a guide, the welder can work close, allowing just 1/16 in. excess metal to finish. The saddles are then sent to the guide grinder and set up by the original square line, being ground to two inches from this line. The saddles are thus brought back to their original blue-print length. This is an ideal grinding machine operation as the deposited metal is somewhat hard, and the grinder not only trues the saddles accurately, but does the work in approximately 25 per cent of the time required on a shaper. The production on the grinding machine, which is illustrated, is about one set of eight spring-saddles set up and ground in one hour.

Maintaining driving-box saddle seats

Driving boxes are cleaned of journal compound, and sent to the lye vat. They are then sent to the driving box gang, where they are inspected for loose brasses, worn shoe and wedge faces, etc. If necessary to strip

the boxes, they are sent to the press where the crown brasses are forced out, the shoe and wedge faces being stripped on a planer, which is found to save time, owing to the dove-tail construction. The boxes are then examined for cracks or other defects, marked O. K., and the brass hub faces and shoe and wedge faces are poured in two operations at the foundry. On return of the boxes to the machine shop, the brasses are pressed in and each driving box is bored and faced for lateral, then going to a small horizontal miller, equipped with an end mill for truing the spring saddle seats. The driving box is clamped square against the face-plate and both seats milled square with the shoe and wedge faces and an equal distance from the bore of the brass, thus assuring that the spring saddle will be vertical and not lean either in the plane of the driving box face or that of the bore.

The hook gage is shown in detail in one of the illustrations and its use in checking the height of one of the spring saddle seats in a driving box is also illustrated. The gage consists simply of a piece of ⅝-in. square stock, bent at right angles as shown and provided with inch graduations, beginning at a point 2½ in. from the bend on the long leg. A one-inch square sliding finger can be tightened by means of a thumb screw at any desired point on the short leg of the gage.

These spring saddle seats usually true up lower than called for by the blue-print size. To determine how much they must be raised, the hook-gage is applied to the driving box, as illustrated, indicating accurately the distance from the saddle seat where the box is milled to the crown of the brass. Adding one-half of the journal size then gives the exact distance from the axle center to the seat. Any variation in this distance from that called for by the blue-print is made up by placing a straight liner of the required thickness in the seat, this liner being temporarily clamped firmly against the saddle seat while tack welding is applied at either end. For future reference, the liner thickness is stenciled on the top of the box opposite each liner. On the next shopping, it will not be necessary therefore, to mill the box again as the remains of the old liners can be removed and liners of the proper thickness replaced. Trailer and engine truck boxes also are checked and brought back to standard in the same manner as driving boxes.

Close journal tolerances

The driving boxes are bored .006 in. larger than the journal, relief being provided at the top of the bearing and grease grooves cut as shown in one of the drawings. This combination, in connection with the use of chilled brasses, is said to have practically eliminated difficulties from locomotive hot boxes on the Chicago & Alton.

The design of the brass shown tends to promote uniform wear and prevent the development of play in the driving boxes, the most important contributing factor in pounding and short life of the bearings. The great care taken to level the spring saddle seats at the proper height has also proved advantageous in equalizing pressure on the driving boxes, preventing hot boxes from this cause, and also eliminating the taper wearing of driving box brasses.

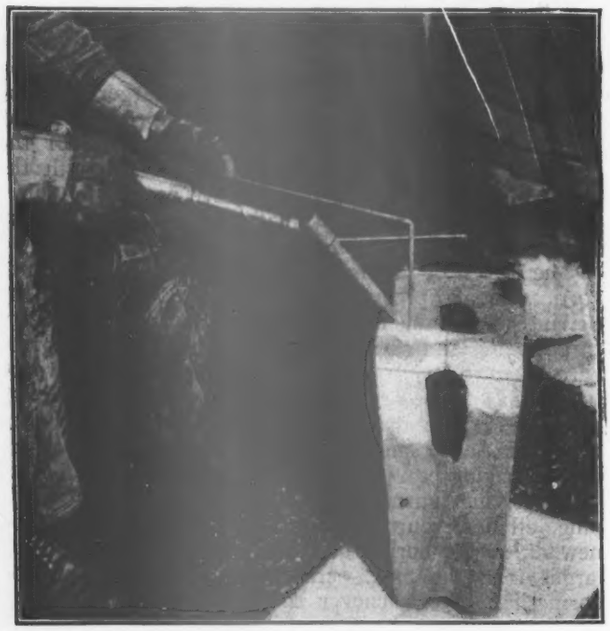
All driving journals are turned at each general shopping, all new journals being ground. In the case of new axles, the boring of driving box brasses .006 in., larger than the axle, permits machining the axle or boring the box whenever convenient without making individual fits. All boxes are bored central in a special universal chuck, micrometer calipers being necessarily used in order to get the desired degree of accuracy. The maintenance of blue print standards makes the shop gangs more or less independent of each other, saves running back and forth to caliper individual

Truing the built-up spring saddles is an ideal grinding operation

journals, obviates delays and gives better workmanship.

Repairing valve motion parts

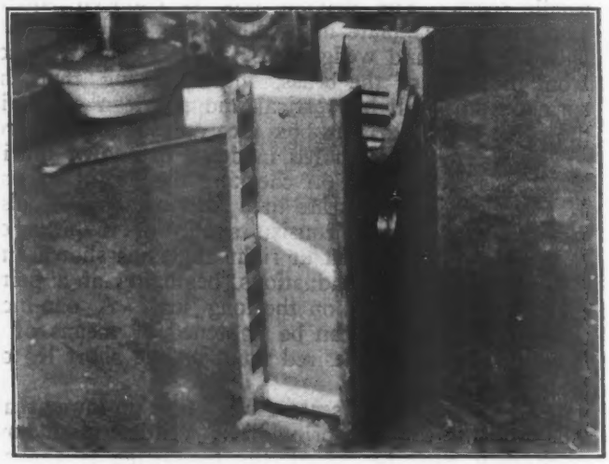
In handling motion work repairs at the Bloomington shops, the material goes to the lye vats for cleaning, and is then sent to the machine shop where it is given



Method of building up worn spring saddles 2 in. above a scribed reference-line

a coat of whiting, and inspected. All eccentric blades and rods are sent to the smith shop where they are annealed, inspected and brought back to blue-print dimensions. If the links are alright, they are reground on the radius-grinding machine in the machine shop. New link blocks, pins and bushings are casehardened and lapped in. These casehardened pins and bushings and the bronze trunnion bushings, doweled in place, last from shopping to shopping. Great care is exercised to secure accuracy, gages and trams being generally used. The links are set up in a special jig which assures accurate alinement. Motion work lateral is taken up by the application of bronze with the oxy-acetylene welding torch. On all passenger engines, the motion work is polished and buffed and a rust preventive applied.

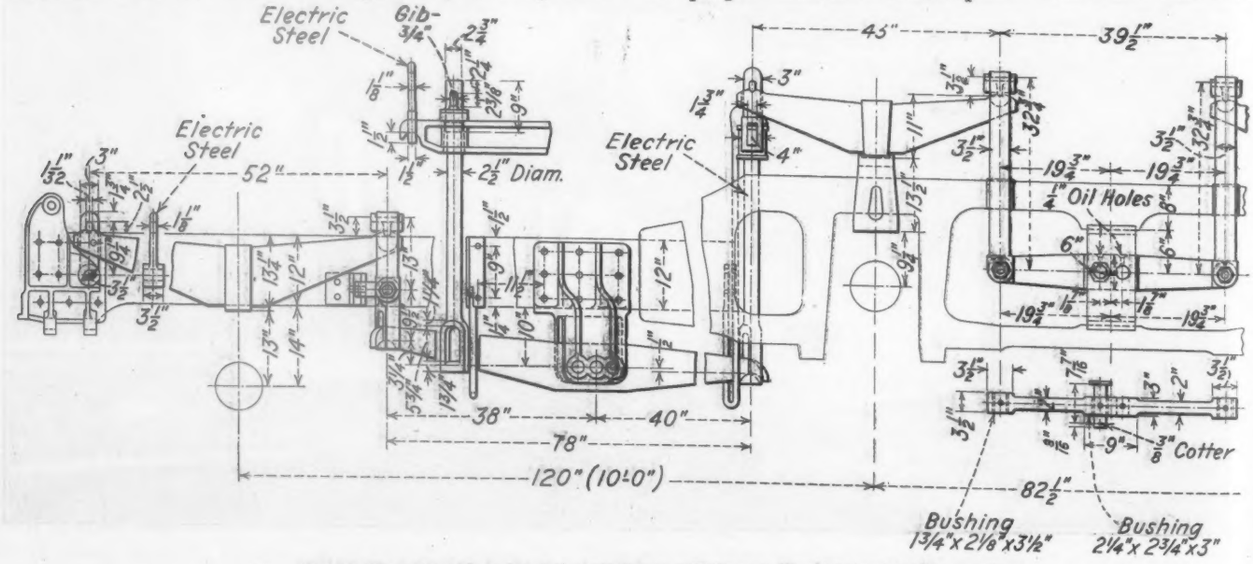
Valve bushings are limited to three sizes, three borings only being permitted to each size. These sizes, as well as details of the special bushing reamers, are illustrated. The 12-cutter reamer, used on a boring bar, gives a smooth accurate bore, and the arrangement for



Crosshead shoe provided with Oxweld manganese bronze inserts

standard sizes permits machining bull rings and packing rings in quantities in advance.

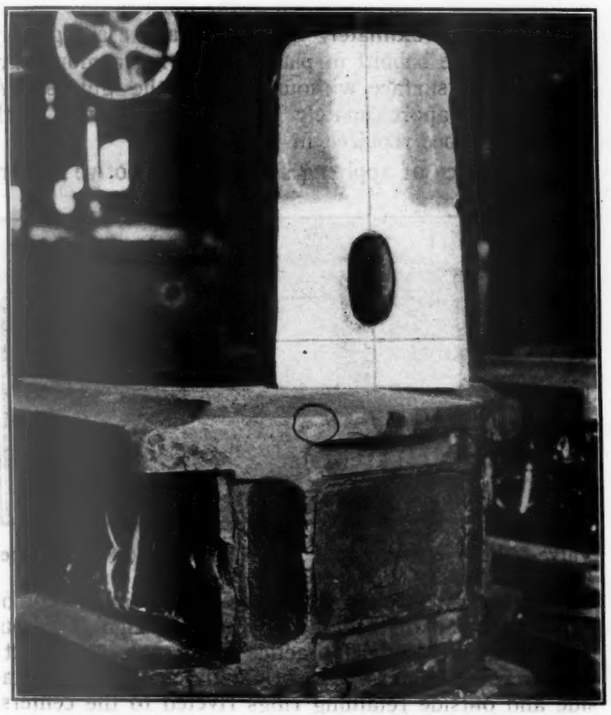
When new valve bushings are applied, the shoulder distances from the cylinder-head faces are checked to make sure that the parts will be central. On application of the bushings, gages are again used to assure the proper distance between parts. All valve rods are ground and the assembled valves put on lathe centers before leaving the machine shop to see that the spool and bull-ring assembly are true. Moreover, the valves are again revolved after application in the valve chambers, and before making the connection to the valve crosshead. This is another important check on the accuracy of the machine and assembly work, since any



Partial elevation showing spring rigging applied to a Pacific type locomotive

lack of alinement will cause excessive wear on bushings, bull-rings, valve rod packing, etc. By the use of Hunt-Spiller packing rings, the valves last from shopping to shopping.

Until recently locomotives were not put on the rolls

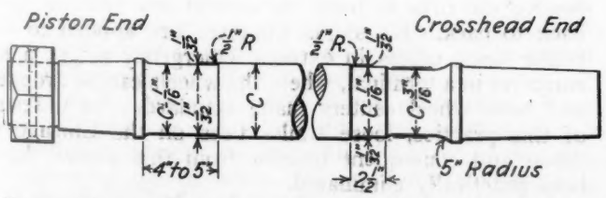


Saddle and driving box brought back to standard—Liner thicknesses in saddle seats are stencilled on the box at points indicated by circles

for valve setting at Bloomington shops, but this practice is now followed for all classes of locomotives. The valves are set in full stroke, one-half and one-quarter stroke, both forward and back, a special set of valve rollers being employed. These rollers are driven by a reciprocating air piston which actuates the small rolls by a ratchet arrangement and permits turning the main wheels under full load.

Variable lead for Walschaert gears

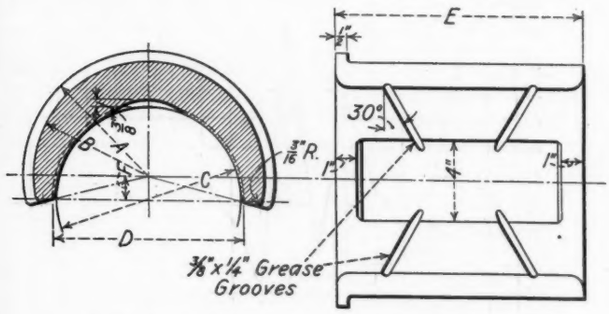
In setting valves, the variable lead on engines with the Walschaert valve gear is obtained by changing the



Locomotive piston rod under-cut to give added flexibility and prevent breaking

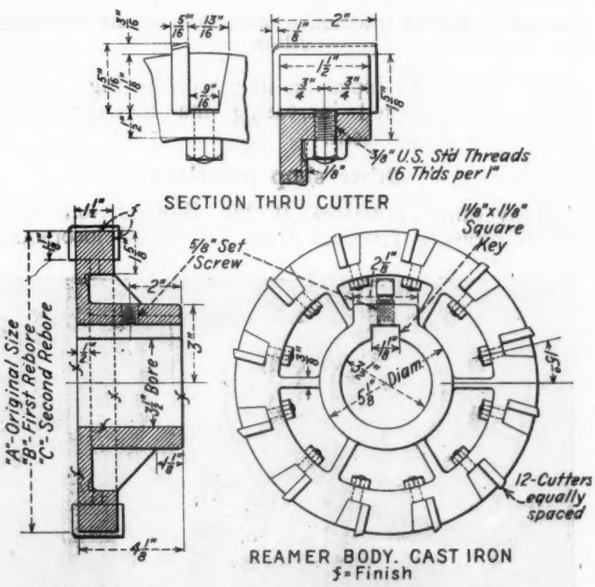
eccentric crank. The gear is laid out the same as when using a constant lead. When the length of the eccentric rod and the correct eccentric circle is obtained, the position of the eccentric pin is advanced or retarded on the original eccentric circle to provide the desired lead with the link block in the bottom of the slot. Then as the link block is brought toward the center of the link, the lead is decreased to that obtained by the ordinary valve setting. Thus, with the eccentric circle remaining the same, the valves are still square, but the events of the valves have been advanced sufficiently to provide for the variable lead.

The valves on Chicago & Alton locomotives are set to provide 1/16 in. lead with the link block on center, ¼ in lead, with the reverse lever in the corner. Ordinarily, Walschaert gear locomotives were provided with 3/16 in. constant lead. With the present setting, the locomotives have an abundance of lead for starting the train. As the reverse lever is hooked up the lead



Method of relieving driving-box brasses

is decreased and, when hooked up to the running cut-off, the lead is reduced to a minimum. This provides

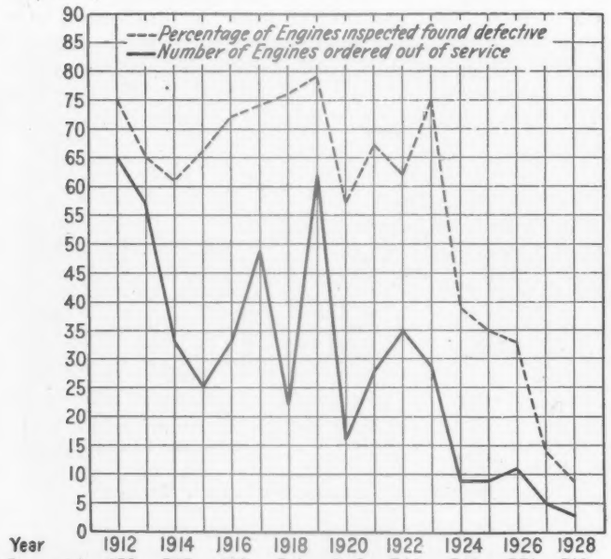


Valve-bushing reamer used in maintaining standard sizes of bore

a smooth-operating locomotive and the pound on the boxes and shoe and wedges at high speed is negligible because of the absence of the constant high compression caused by constant lead. Also, at high speed, the energy developed in the counterbalance of the driving wheels provides a force sufficient to retard and change the direction of the reciprocating parts without the aid of so much lead. This allows the steam to come to the face of the piston in sufficient time to exert its force at a better angle on the crank. With the usual constant lead at high speed, and short cut-off, a great amount of force is thrown on the piston on dead center and in turn into the boxes, and wedges. The effort

thus used, never gets to the crank circle to turn the wheels, and is more or less useless in moving the train.

An evidence of the effectiveness and general desirability of the method of valve setting employed on Chicago & Alton locomotives, is afforded by dynamometer car tests of 14 locomotives in July and August,



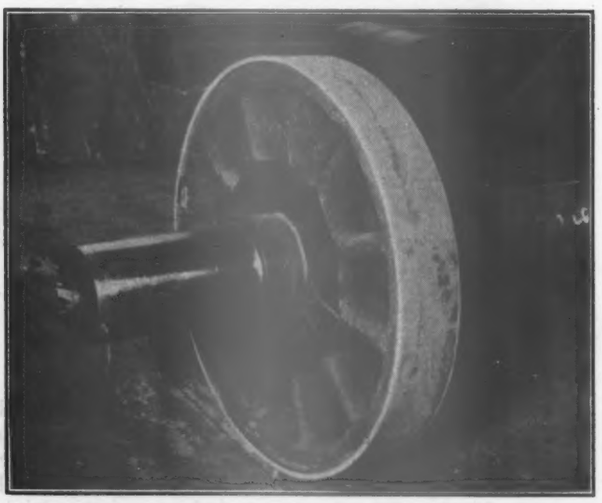
Year	1912	1914	1916	1918	1920	1922	1924	1926	1928
Eng. owned	258	345	327	319	342	341	341	331	319
Eng. inspected	407	557	343	369	279	389	261	509	453

Record of federal locomotive inspection on the Chicago & Alton

all of which developed an unexpectedly high tractive force and permitted increasing the tonnage ratings from 20 to 25 per cent.

Other shop practices

Many other practices at the Bloomington shops, which promote freedom from failure of locomotives

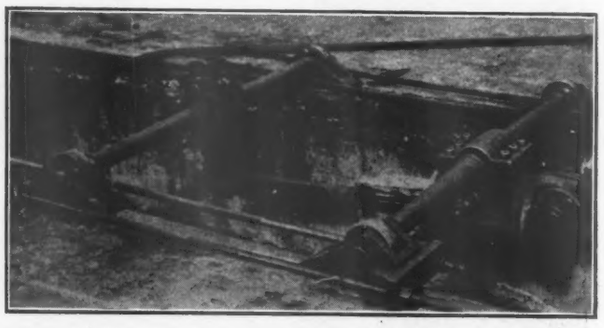


Banded trailer wheel which obviates shimming trailer tires

on the road and thus increase the efficiency of operation, could be mentioned. One of these practices is the use of under-cut piston rods as shown in one of the drawings, which saves breakage by increasing the flexibility of the piston rod and, moreover, is said to increase packing ring and bull-ring life. The piston end is under-cut 1/16 in. in diameter and the crosshead end 3/16 in. in diameter as illustrated.

Another somewhat unusual practice is the use of Oxweld manganese bronze inserts in the crosshead shoes one on each end and one diagonally across the center of each shoe as shown in the illustration. These inserts are approximately ¾ in. wide and assist greatly in holding the babbitt in place and giving a more durable bearing surface without cutting the guides. A mileage of approximately 30,000 is obtained with crosshead shoes repaired in this manner.

The practice of applying shims to locomotive trailer-



Valve-setting rolls operated by an air cylinder and ratchet

wheel centers on both passenger and freight locomotives, has been discontinued by the Chicago & Alton, the following standard practice being put into effect: Trailer wheel centers were originally equipped with inside and outside retaining rings riveted to the centers, thereby holding the tire in place. When these wheel centers have seen considerable service the centers have been turned at various times to maintain them round, thereby frequently necessitating shimming at the back shops on account of the tires being too large.

To avoid shimming and consequent possibility of loose tires, trailer wheel centers are now turned ¾ in. below the normal blue-print diameter to make room for a ½-in. by 5-in. welded steel band that will finish ⅜ in., bringing the wheel center back to the original size. This band is secured by five or six dowels. It is 5 in. wide in order that the retaining ring or lip on the tire will bear against the band, thereby not allowing a space between the lip and band, which permits the inspector to think that the tire has loosened and is working outward.

All bands are of sufficient width that the retaining lip of the tire will come in contact with the band, allowing the tires to have the correct tire spacing from back to back. No shims whatever are applied to the trailer tires, unless in extreme emergency to get a locomotive to a terminal, where the wheels can be dropped and have wheel centers made standard. As a result of this practice, loose trailer tires on the Chicago & Alton and consequent trouble from this source, have been practically eliminated.

ARC WELDING.—"How to Begin the Application of Arc Welding in Production Manufacturing" is the title of a 32-page supplement to the 160-page text book, "Arc Welding—The New Age in Iron and Steel," being distributed by the Lincoln Electric Company, Cleveland, Ohio. The redesign of machinery and the principles involved are discussed, and line drawings show how standard steel shapes are utilized to build up structures which formerly would be cast. Photographs also illustrate similar designs in actual use.

The eternal argument about shoes and wedges

Two methods of doing this work are discussed—Do you agree with the conclusions arrived at?

By Warren J. Ichler

IT was the noon hour at the shops of a railroad of the middle west and there was an argument on between two of the senior apprentices about the relative merits of different methods of laying out shoes and wedges.

It seems that individual shop procedure about shoe and wedge layouts has to be settled with each yearly crop of apprentices and that, even with standard procedure laid down for them, these graduating mechanics accept with reservations all that is told them about the geometrical constructions involved in this work.

Apprentice Smith opened the argument: "The fish-tail tram method is the only proper way to lay out shoes and wedges and if you think about it for a little while, Jones, you will have to admit that this is so."

"Gwan," said Jones, "you couldn't pull that stuff over in Gang Two, where I work, and get away with it. Over there we run lines through the cylinders and make sure of the alinement of the whole engine, and I haven't heard of any of the locomotives we send out cutting their tires. Lining through the cylinders is the only proper method of making the shoe and wedge layout, isn't it, Mr. Brown?"

The latter part of Jones' statement was directed at the apprentice supervisor, who had just joined the little group about the two apprentices.

A discussion of the two methods

Brown filled his pipe very deliberately and, after surrounding himself with a cloud of tobacco smoke, said, "As usual in any argument, both of you are partly right in your assertions and part—the greater part in fact—of your premises are all wrong.

"Let's begin at the beginning of this whole matter and consider a few fundamental facts. In the first place, both of you will have to admit that no measurement, or transfer of a measurement from one point to another, can be more accurate than the skill of the mechanic taking the measurement or transferring that measurement from point to point on any surface. I take it that both of you agree with me on that point.

"Secondly, after the plane of the center line of the main driving axle has been established, there is almost no variation between the several methods of scribing and transferring the measurements involved in laying out the positions of the other axles of a locomotive.

"Now, since there is a possibility of an error in setting dividers, or trammels, at every stage of the work and a further liability of an error being made when marking on locomotive frames with the trammels, or dividers, and a still further possibility of wrongly recording the measurements so laid out; that is, wrongly marking them with a center punch, it would seem best to use that method which involved the least number of such operations and hence the least possibilities of error.

"Going back to the second basic fact that I gave you fellows; that is, the assertion that, after the center line of the main driving axle had been established, there was no variation in the methods of procedure in the whole layout thereafter, we might deduce a third basic principle, which could be stated thus: All errors introduced into a shoe and wedge layout, after establishing the main axle centers, are secondary in importance to the fundamental errors introduced into the layout in establishing the first set of driving-axle centers.

"Put in other words, this last statement merely means that if the main driving axle center line is not located perpendicular to the longitudinal center line of the engine, the positions of all of the remaining axles will be wrong because all of the subsequent layout is dependent upon this base line and is struck from it.

"Of course, in the performance of the engine this would mean that if the main-axle center line was wrongly located, all of the driving tires on one side would tend to cut their flanges against the rail, rather than merely one or two as would be the case if errors had crept into the layout after the main axle line had been properly established.

"This emphasizes the importance of extreme care in the first stages of your layout work and brings me to the final stage of this lecture I have been giving you two fellows.

"The assertion that it was preferable to use those construction methods which involved the least number of measurements and the least amount of drawing of these measurements would seem to be an argument in favor of using a fish-tail tram, which method is least time-consuming, rather than establishing the cylinder alinement. The trammel method is also least annoying to other mechanics working around the engine at the time the shoe-and-wedge men are at work. However, I have also stressed the importance of guarding against fundamental errors in the whole layout and it must be noted that, unless it is carefully checked, the fish-tail tram method offers more opportunities than does the cylinder alinement method, for these initial errors do creep into one's work. From these considerations, you boys will appreciate that from the general construction of the engine and the class of repairs it is receiving, you will have to formulate your own conclusions as to which method of establishing your main axle centers is best for each individual case."

Where each method is best

"My own rule is this. If the engine is old and there is any question about the alinement of the boilers with the frames, or the frames with the cylinders, I will test these alinements in the usual way with the lines run through the center of the cylinders and, of course, while these lines are in position it is easy enough to establish the center line of the main axle perpendicular to the two given lines. This method also holds good if there are

many waist sheets, cross-ties, or other members between the frames which would make it difficult to use a long fish-tail tram to advantage. Usually though, most foremen look upon the cylinder alinement method as too time-consuming and prefer to have their work done under other methods.

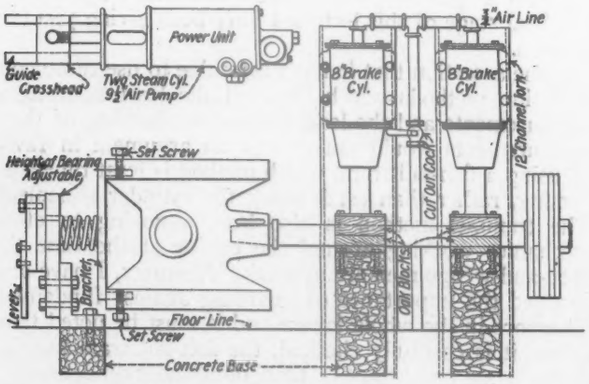
"Summing up, I want to impress upon you fellows that my own preference is for the cylinder alinement construction in every case, not because it is more positively accurate than other methods, but because it furnishes a means of checking up the alinement of all other main parts of the locomotive. Just remember that there are several other recognized methods of making this construction and that it will repay both of you to study them all and to consider them all from the standpoint of the probability of errors involved, rather than to study intensively any one particular method and to place too much faith in that method merely because you are familiar with every detail connected with it."

Device for grinding crosshead piston rod fits

By J. H. Hahn

Machine shop foreman, Norfolk & Western, Portsmouth, Ohio

IN many locomotive repair shops where it is the practice to grind the piston-rod fits in the crossheads, various methods are employed for doing the grinding. Some shops resort to grinding by hand which is slow and tedious; other shops employ power-operated devices. The device shown in the illustration is a simple and handy machine for this work. The two vertical columns are made from 12-in. channels about



A device used for grinding and fitting crossheads on piston rods

8 ft. long, which are set in concrete. The concrete bases extend about 20 in. above the floor level. The two oak blocks which are mounted on the concrete bases are machined in half circles to receive the various sizes of piston rods. Two 8-in. by 10-in. air-brake cylinders are mounted on the upper ends of the channels. The upper halves of the oak blocks are secured to the ends of the brake-cylinder piston rods. A cut-out cock is placed in the ¾-in. air line for controlling the air to and from the two cylinders.

The piston rod to be ground is placed between the two oak blocks and the air pressure applied, thus securely holding the piston in place. A supply of grinding compound is put on the end of the rod after which the crosshead is placed in position. A bracket, shaped to fit in the crosshead guideways, is clamped by two set screws onto the opposite end of the crosshead. A circular arm, parallel to the center line of the piston forms part of the crosshead bracket.

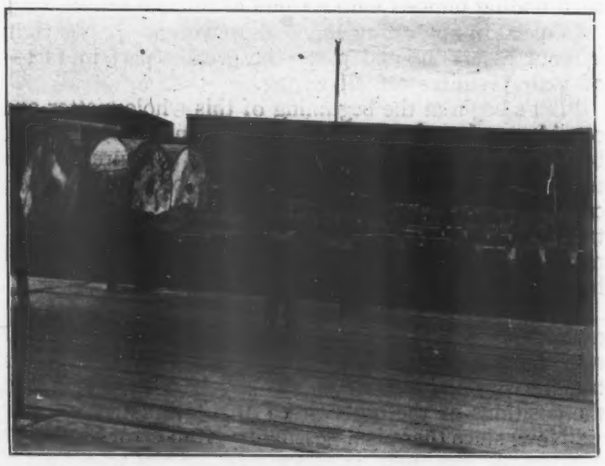
A coil spring is placed around this arm for the purpose of applying the proper tension or pressure to the crosshead during the grinding operation. A rotating plate is attached to the end of the arm. A lever connects this plate to the crosshead of the driving unit, which is made from two 9½-in. air compressor cylinders and operated by the standard steam head. The power unit is located about 18 in. below the floor level in a concrete pit.

The piston rod should be turned occasionally while the grinding is in progress. Very little grinding is required if the fit of the rod in the crosshead is properly made and the rod and the bore of the crosshead are smooth. When fitting new rods or refitting old rods, the crossheads should be reamed first to insure a smooth bore to which to fit the rod. The grinding should be started with a medium grade of grinding compound and finished with a very fine grade.

The clamping feature of the device is also used when assembling the pistons on the rods and for fitting the crossheads to the pistons. The crosshead is placed on a small four-wheel truck. The height of the bed of the truck is adjustable for different classes of crossheads. The piston rod is clamped on the oak blocks. The use of this truck eliminates the use of blocks when fitting and assembling crossheads and pistons, and also eliminates excessive handling.

Orderly storage of locomotive springs

THERE is no sorting of locomotive springs from unsightly piles at the storage platform of the Denver & Salt Lake shops at Denver, Colo. The work of loading them onto a truck for conveyance to a locomotive,



A locomotive spring storage rack that provides ample room for a truck to move between them

is greatly facilitated by the method of storage shown in the illustration.

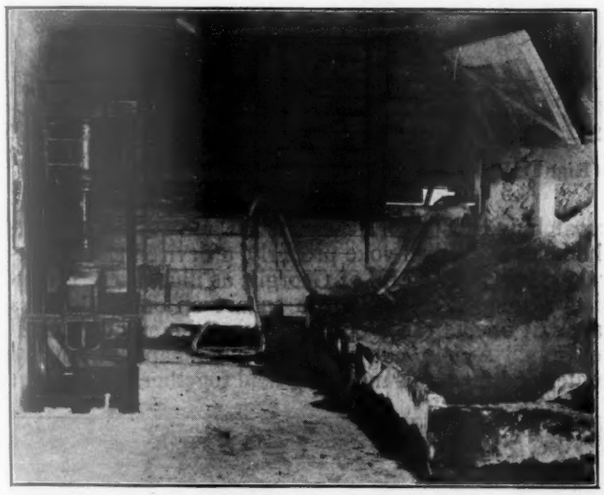
A series of racks is made by welding 12-ft. sections of rail on top of three 3½-ft. pieces of 1-in. by 4-in. steel, bent to form three pairs of legs, as shown in the

illustration. The rails are about 7-in. apart. The springs are placed side by side in the 7-in. gaps between the rail sections, at right angles to the center line of the rack. A semi-circular strip of metal is welded on the ends with the end pointed upward to prevent any of the springs slipping off the end of the racks. These racks are placed far enough apart to allow free passage between the rows of springs. The springs are about 18-in. off the storage platform.

Handling lagging at B. & M. Billerica shops

DURING October, 1927, the Boston & Maine installed equipment in the Billerica shops for reclaiming asbestos lagging, salvaged from retired locomotives and from locomotives in the shops for class repairs. The lagging is reclaimed in a one-story building, located at the south end of the boiler shop, which adjoins the locomotive erecting shop. Four rooms are provided for storage, grinding, forming and drying, respectively.

The Ferry motor-driven grinding machine can be adjusted to grind the lagging to any desired size. The shop-made forming press consists of a brake cylinder mounted on a strong frame and operated by a two-way cock. The moulding box in which asbestos slabs of



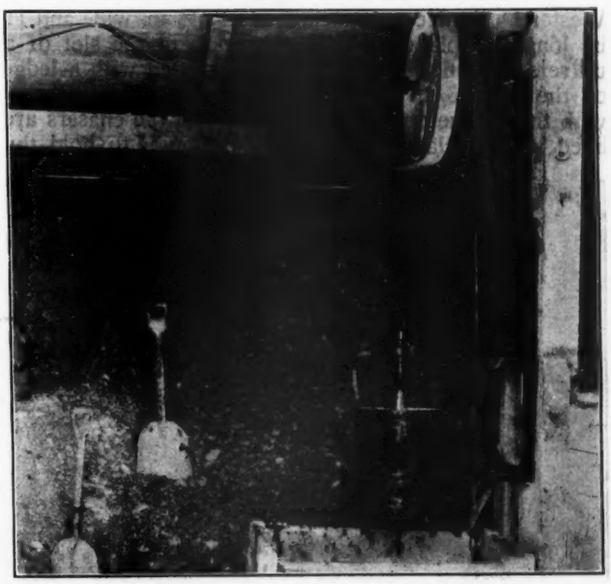
The mixing and forming room

regulation size can be pressed is located directly beneath the brake piston. The required slab thickness is obtained by the use of wood liners ½ in. thick, any number of which may be placed in the moulding box.

The liners are set on top of the pistons of two small air cylinders located directly beneath the moulding box. After the slab has been pressed into shape, the two pistons push the slab out of the form, which permits the operator to place it in the drying room.

One laborer makes all of the asbestos slabs for the locomotives undergoing class repairs in the Billerica shops. The old lagging is dumped into the storage room, from which it is shoveled into the grinding room. After considerable experimental work, it was found that it was not necessary to grind the lagging into fine parts, but that large lumps would work just as well. The roughly ground lagging is then shoveled through an opening in the wall into the forming room, where sufficient water is added to make it plastic, but not soft. Care is taken to prevent excess water from getting into the mix, as it is more difficult to handle in the former and requires more time to dry out.

After the slabs have been formed, they are placed in



The machine in which the lagging is ground

the drying room where a temperature of 112 deg. F. is maintained by steam pipes. They require from 48 to 60 hours to dry so that they may be handled. The locomotive boilers are lagged with slab asbestos up to the center line and the remainder is covered with plastic lagging.

A saving of $870 was effected during the first month

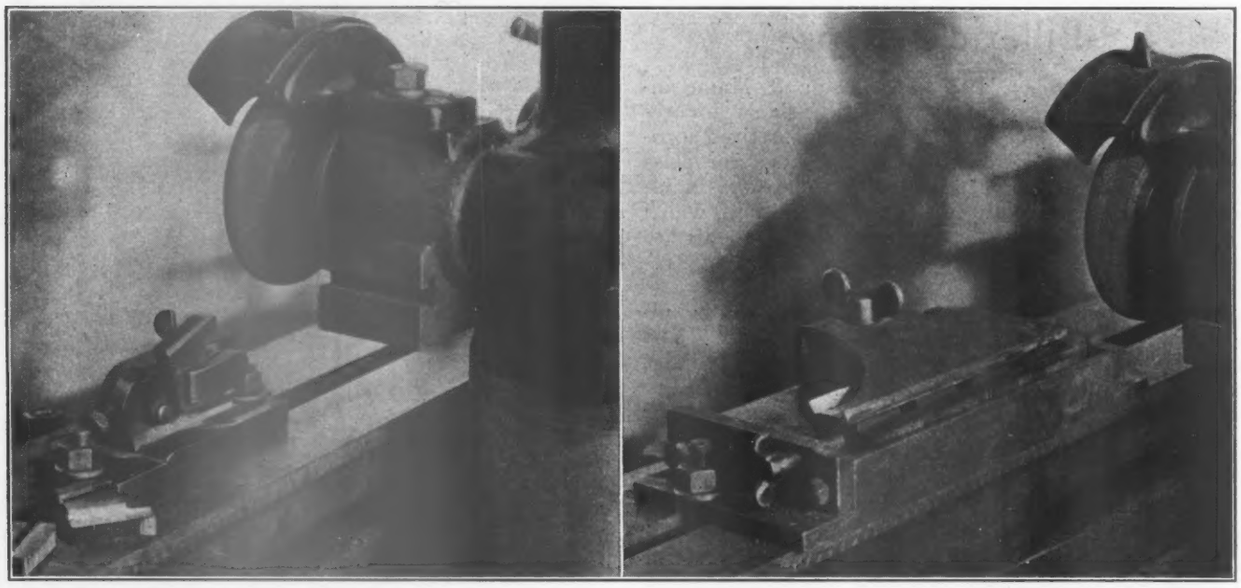
A temperature of 112 deg. F. is maintained in the drying room

the equipment was in operation. During the first seven months that the equipment was in operation, a total of 128 tons of asbestos was reclaimed with a savings of approximately $7,000. The amount of lagging purchased has been reduced by 70 per cent.

Shop jigs and devices *

DIE chasers must be ground parallel, and all in the same set ground to the same thickness. With this end in view, the jig illustrated at the right was made at the Roanoke, Va., shops of the Norfolk & Western. A piece of machine steel 4½ in. wide and 11 in. long was planed with a tongue to fit the slot of a universal grinder, and the top side planed with a ledge on the front 3/16 in. high and 3/16 in. wide, parallel with the tongue on the bottom to which the chasers are lined up. A clamp is made wide enough to hold the complete set; a piece of cardboard is placed between the chasers and clamp, and a thumb screw is used to hold the clamp. In this way the full set is ground on the face with one setting and with the assurance of all being alike.

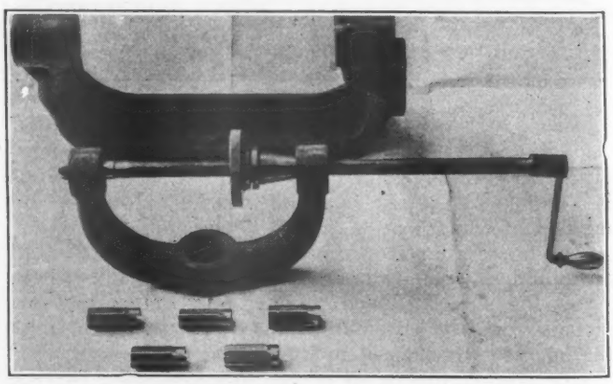
Chasers for brass are ground with a straight wheel. Chasers for tough steel are ground with a wheel dressed with a radius, which gives the chasers a good rake and causes the shavings to come off freely, leaving a good clean thread. The throat of the chasers is ground in the jig illustrated at the left. This jig is planed with a tongue in the bottom to line it up quickly on the grinder. A stop is arranged so as to be adjusted to the angle best suited to the job the chasers are to be used for. For Geometric chasers, a headless screw with screw-driver slot is put in the stop to engage in the slot of the chaser. For H & G chasers, the second stop is a screw which passes through the web of the jig with a straight, plain end about 1/8 in. long and 3/16 in. in diameter which engages the slot in the chaser. The wheel is dressed with a radius and the table of the machine swung at an angle to the wheel. The angle of the table depends on the size of work the chasers are to be used for. The throat of only one chaser of the set can be ground at a time; but with these stops and clamps, and the little stock to be taken off, each is ground in turn and they are all the same, which is essential. Chasers with milled threads are generally ground on the throat to keep them in shape, while tapped chasers are ground on the face, as shown at the right in the illustration. Thus it will be seen that milled chasers are best where it is not necessary to run up to a shoulder and tapped chasers are the only ones to use when a thread has to be cut to a shoulder. With this set of jigs properly used, the chaser grinding problem is solved.



(Left) Jig used in accurate grinding of chaser throat—(Right) Jig for uniformly grinding chaser faces

Reaming bell yokes and frames

As all familiar with the operation of a bell on a locomotive know, the holes in the bell yoke must be accurately in line or the bell will stick and bind. To aline the holes in the bell yoke properly, a device has been developed on the Central of Georgia, as illustrated. It consists of a long screw with a square on one end and a taper fit on the other end to receive the standard shell reamers. A split nut, which is cone shaped, acts as a center and feed, this nut being held together with a large knurled nut. A crank is used to turn the reamer. The yoke is placed in the vise. The long screw is put through the hole on one side of the yoke. The knurled nut is slipped on, and the proper size shell reamer is placed over the split nut. The crank is then placed on



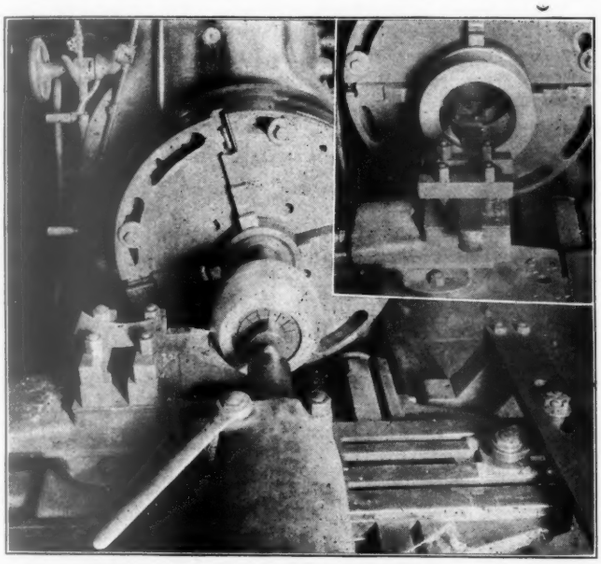
Device for hand reaming bell yoke holes in accurate alinement

* Additional jigs and devices described in the committee report on this subject, read at the Chicago convention of the American Railway Tool Foreman's Association by Chairman W. R. Millican, president-elect of the association, and tool foreman of the Missouri-Kansas-Texas at Parsons, Kan.

over to the second side, and the split nut placed so it will enter the first side, after which the knurled nut is placed over the split unit. The crank is then placed on the square end of the long screw, and, with the left hand holding the knurled nut, the device is ready to operate. The threads on the screw, which are 32 per inch, provide the feed. As soon as one hole is completed the reamer is reset for the opposite hole and the above operation is repeated.

Machining articulating joint ball and bushing

Orders were received in the Norfolk & Western machine shop at Roanoke, Va., to equip a certain class



Set-up for machining articulating joint ball—(Insert) Machining the bushing

of Mallet locomotives, as they were repaired, with the ball articulating joint which would make them more flexible in taking curves than the regular hinge joint. After discussing different methods of machining the ball and its socket bushing, it was decided to equip a certain lathe for the job, as illustrated.

The machine selected was a Niles-Bement-Pond, 36-in. lathe, with taper attachment. The rail was taken off and two brackets made, and on these brackets was placed a machined bar of steel, 1½ in. by 6 in. by 48 in. long, in which a slot 12 in. long was cut in line with the center of the carriage. When it was in position with the tool in the center of the ball, a stud was made and fitted to the cross-slide, another being fitted so it could be adjusted in the slot of the rail, and a link made to connect these studs. The distance between centers of the link was the radius of the ball which is 6¼ in. The ball, a drop forging, is chucked and bored in the usual way, pressed on an expansion mandrel, placed between centers, and the nut of the cross-feed disengaged. A narrow pointed tool, with the point slightly rounded so as to make a smooth cut, is placed in the tool post with the cutting edge in line with the centers, the carriage being moved so that the tool is in line with the center of the ball. The link stud is then adjusted in the new rail in line with the stud in the cross slide and tightened, the carriage being moved so that the tool is ready to cut at the edge of the ball. The compound is used to feed in the tool for the cuts. The practice is to start the lathe and engage the feed as in a straight cut, and turn to center; then start from the other side of the ball, reverse the feed, and turn to the center. This takes out the back lash. The balls are turned to snap gage which makes them interchangeable.

The split socket bushing is a drop forging and is in halves. The first operation is machining the joints. For the second operation, the halves are chucked together in a vertical lathe and turned on the outside to the size of the flange for half their length, then taken off and numbered so that these parts can be kept together. In the third operation, four dowel pin holes are drilled. A jig is used to insure the parts matching up properly. In the fourth operation, the dowel pins are put in and the halves put together and chucked in the lathe. A special boring bar is placed in position with the tool ground the same as tools for turning the ball. The tool is set in the center of the bushing and the stud tightened in the new rail. The procedure then is the same as for turning the ball. The bushings are bored to gage, the link then disengaged, the cross feed nut engaged, and the tools changed in the boring bar, the outside of the bushing being turned to size.

Welding with bronze on the Wabash *

By. G. M. Calmback
General welding supervisor, Wabash, Decatur, Ill.

EACH day presents new possibilities for the applications of bronze welding, which is doing more to revolutionize welding in railroad shops than anything else of which I can think. We speak of welding this or that with bronze—are we welding or are we brazing, or both. For example, we want to unite two pieces of steel 2 in. square. To do this, it will be necessary first to bevel the pieces and, then apply the bronze to the steel. To do this, it is only necessary to heat the steel to a red heat; this is what we call brazing. In welding, the vees are filled from edge to edge, which makes it necessary to fuse the bronze. Is this welding or brazing?

Two welds made at Decatur, Ill., enginehouse October, 1927, 5 in. by 6 in.

2 operators, 12 hrs.	@	81c	$ 9.72
360 cu. ft. oxygen	@	1c	3.60
355 cu. ft. acetylene	@	2½c	8.88
55 lb. bronze	@	28c	15.40
1 lb. flux	@	50c	.50
			$38.10

In making this weld, it was necessary to insert a section of frame 22 in. long.

Steel or iron when brought to a white or plastic heat is in a burned state. When the blacksmith works his metal in this state under the hammer he refines it, which cannot be done when welding with the torch or the arc, as with these two processes we have really eliminated the most important characteristic necessary in the metal, which is ductility. When welding with bronze, the parts affected by the heat are treated by an annealing process for the reason that a red heat is all that is necessary for bronze. The red heat gives the necessary ductility and strength, thus making bronze welding especially adaptable to locomotive frames and other parts affected by vibrations and fatigue.

On the Wabash, bronze was looked upon rather

* Abstract of a paper read at the Gas Product Association convention held in Chicago, January, 1928.

doubtfully, until an opportunity presented itself to weld a broken frame. The break happened to be an electric weld and at a point difficult to reach. As we could not drop the wheel for the lack of facilities, it was necessary either to deadhead the locomotive to a shop where drop pits were available or to take what was then thought a chance with bronze. I wired the master mechanic, asking permission to do the job with bronze. He had some confidence in my judgment and his answer was, "Do anything you wish." This was my first heavy weld with bronze and was made, about four years ago. I might say that this job failed, after 2½ years constant service, but we rewelded with bronze and the locomotive is still in service.

A right front pedestal top rail, 5 in. by 6 in., welded at Moberly, Mo., during October, 1927

2 operators, 3 hr. each	@	81c	$ 4.86
260 cu. ft. oxygen	@	1c	2.60
255 cu. ft. acetylene	@	2½c	6.38
38 lb. Tobin bronze	@	28c	10.64
1 lb. bronze	@	50c	.50
			$24.98

This was an old electric weld which had to be entirely removed, leaving an opening in the frame to be filled 1¾ in. at the center of the frame and 4 in. at the outside edge of the vees. A ⅝ in. reinforcement was added.

On the Wabash, the following car parts are welded with bronze:

Building up worn spots on column bolts, malleable castings, cast steel body bolsters, roller-bearing truck bolster castings and cast steel striking castings. Malleable iron buffer plates, coach truck pedestals, center plates for freight cars and the malleable iron draft arms on freight cars are also welded with bronze. These draft arms are subjected to severe usage and tests show them to be in first-class condition after 18 months of service.

A right front 6-in. by 7-in. jaw welded at Vandeventer during January, 1928

2 operators, 2 hrs. each	@	81c	$ 3.24
160 cu. ft. oxygen	@	90c	1.44
155 cu. ft. acetylene	@	2½c	3.88
30 lb. bronze	@	27c	8.10
¼ lb. flux	@	50c	.25
			16.91

In locomotive work all brass parts, such as injectors, lubricators, valves, bells, etc., are welded with bronze.

A right front 7-in. by 8-in. jaw welded at Vandeventer during January, 1928

2 operators, 2½ hr. each	@	81c	$ 4.05
180 cu. ft. oxygen	@	90c	1.62
175 cu. ft. acetylene	@	2½c	4.38
40 lb. bronze	@	27c	10.80
1 lb. flux	@	50c	.50
			$21.35

This was a double weld which made it necessary to insert in the frame a section 16½ in. long.

Bronze is also used in filling all holes that are to be redrilled. All cylinder cock rigging, bell clappers and stands, reverse levers and quadrant rigging, air operated fire-door rigging and all similar work are welded with bronze, and, worm guides, worn side and main rods, worn piston heads, gear teeth, steam pipe joints, worn or cracked smoke stacks, and rod fits on main rod brasses are built up with bronze. Bronze is used in welding locomotive cylinders and, in some cases, locomotive frames. Bronze is also used in welding driving-wheel spokes, cast iron and steel, welding frame braces and deck castings and in the brazing of all malleable-iron castings. Bronze is used where two different metals are to be united, such as brass and steel, cast iron, etc.

The tables give some cost figures covering various types of welds. It will be noted that the cost averages between seven and eight dollars per hour to make a bronze weld.

Spring making and repairing—A correction

DUE to an error not chargeable this time either to the editor or to the printshop, a misquotation occurred in the report "Spring making and repairing," presented before the 1928 convention of the International Railway Master Blacksmiths' Association by George Fraser, blacksmith foreman Atchison Topeka & Santa Fe, Topeka, Kans., as reported beginning on page 572 of the October *Railway Mechanical Engineer*.

Referring to the necessity of semi-elliptic locomotive springs conforming to a uniform radius from end to end under the working load for best results, Mr. Fraser was quoted as saying, "In order to obtain a spring of this type, it has been fully demonstrated that not more than three full leaves should be applied to springs having more than 60-in. centers." This sentence should be corrected to read "three full leaves should be applied to springs having 60-in. centers or less, and not more than four full leaves for springs having more than 60. in. centers."

Guide repairs for Duplex stoker slides

By A. T. E.

ONE of the troubles which occasionally develops with the Duplex stoker is the failure of the guides provided for the conveyor plates to work in. When this occurs, the usual way to correct it is to put the back end of the conveyor on horses as the tender is pulled back and away from the conveyor, and than rivet new pieces in place to form a new set of guides, or to repair the broken section.

A simpler and easier way to make the repairs is to weld a piece of ⅜-in. by 2-in. by 2-in., or ⅜-in. by 2½-in. by 2½-in. angle to the side of the stoker angle ring. The length, usually from 8 in. to 24 in., is varied to suit conditions. If such an angle section is not in stock, a piece can easily be forged out of ⅜-in. plate or bar stock. Care must be taken to see that the top of the angle is no higher than the top of the angle ring. As the top portion of the guide is usually in good condition, the slide will work satisfactorily between this top portion and the angle section. This is a good temporary job that can be done quickly, and should render satisfactory service until the locomotive is shopped for class repairs.

INDUCED DRAFT.—The Bayley induced draft and exhaust fan system as applied to the firing of locomotives and the exhausting of gases at the Williamson, W. Va., enginehouse of the Norfolk & Western, and the operating results obtained since its installation over one year ago, are described in Bulletin No. R1 issued by the Bayley Blower Company, Milwaukee, Wis.

The Reader's Page

Have You a Question? Ask it
Have You an Opinion? Express it

Tank car maintenance

NEW HAVEN, CONN.

TO THE EDITOR:

A question was asked by Mr. Burnham in the July, 1928, issue of the *Railway Mechanical Engineer* in regard to sill steps on tank cars. Tank cars equipped with side platforms must have the sill step located not more than 18 in. from the end of the car to the center of the tread. There is no minimum requirement. The law states the maximum distance only. On tank cars without side sills, the sill step must be located under the hand holds. The center of the hand hold (clear length) and the center of the tread of the sill step must coincide. On this type of tank cars, the law does not specify any minimum or maximum distance that the sill step must be located from the end of the car. The law does require that the hand hold must be not more than 12 in. from the end of the car, measured from the outer edge of the hand hold.

On tank cars without end sills, the sill step must be located as near the end of the car as practicable. There are no specific requirements as to minimum or maximum distance from the end of the car.

The data mentioned in the preceding paragraphs apply to all classes, except those cars as mentioned in the conference ruling issued December 8, 1920, by the Interstate Commerce Commission. This ruling states that "cars of special construction, as contemplated by the commission's order of March 13, 1911, are cars which cannot be equipped with safety appliances as prescribed in the order for any of the specified classes enumerated in the order therein."

In the construction of new equipment which does not conform to the specified classes designated in the order, plans shall be submitted to the commission, prior to the construction and application thereto of all safety appliances required by statute and by the I. C. C. order of March 13, 1911.

In view of the above facts, it may be advisable to state that cars of special construction must have the same complement of safety appliances as are required for cars of the nearest approximate type.

JAMES W. MCDONNELL.

What do you think?

IN the air brake room, is it necessary and advisable to scrape triple valve slide valves and brake valve rotary valves to a surface gage before performing the final lapping operation which will enable these valves to pass the rack test?

Do you honestly inspect your tank valves?

BELLEFONTAINE, OHIO.

TO THE EDITOR:

Occasionally we meet the foreman who seems to be either too busy or too tired to inspect the valves of tanks going through his shop. He seems to think it the proper procedure to leave this work to the federal inspector when making his regular monthly inspections. Usually when trouble occurs, foremen of this type are always certain that "Jack" looked at those valves and reported them to be all right, when explaining to the boss how it happened.

Just for your own satisfaction, did you ever count the number of tank valves, stems, strainers, or valve handles that "Jack" has ordered changed or repaired during the past six months? It might also pay to examine a few tanks to see if the valves operate as you would like to see them. Sometimes the knowledge obtained, if one inspects a tank valve when the injector, water pump, inspirator, or centrifugal pump is not supplying the boiler, proves to be quite interesting. The trouble, is not always in the boiler check, a branch pipe partly scaled up, a bad injector, a dirty screen, or a collapsed hose. Going inside a tank, like crawling into the pit, calls for a little more time and effort than making an inspection of some outside part.

Sometimes the foreman will crawl inside the tank and have the mechanic open and close the valve several times. The first time it opens perfectly and perhaps it will repeat later on. But frequently the valve will lack 25 or 30 per cent of opening as wide as it should. It may be that on some types of valves it will open too wide (turned too far and partly shut off). The mechanic will give the valve his OK with honest intent, and a short time later the foreman will have to condemn it. After all, there is only one solution; namely, correct your methods of inspection.

Inspecting tank valves may appear to be only of minor importance, especially as it is such a simple and, usually reliable piece of equipment. But it can make trouble, and it may not be right even if you obtain a full stream of water from the hose when you drop it. A little lost motion in the valve can cause considerable trouble, for there are some tank valves so designed that when they are wide open, they do not have a correspondingly large passage area.

A. T. E.

HOUGHTO-CLEAN.—A brief outline describing the use of Houghto-clean series of cleaning materials for metal working plants is given in a 36-page booklet issued by E. F. Houghton & Co., Philadelphia, Pa. Houghto-Clean is intended to remove cutting oils, drawing and stamping compounds, quenching oils, and other processing materials left on the work during various metal working operations.

METAL-CUTTING COOLANT.—Hocut, a transparent water soluble metal cutting coolant, is described in a 20-page brochure issued by E. F. Houghton & Co., Philadelphia, Pa. This oil is mixed with water in proportions varying from 1 to 30 for general cutting purposes and 1 to 60 for grinding.

A 64-in. by 60-in. planer-type milling machine

A LINE of planer-type milling machines of various sizes has recently been placed on the market by William Sellers & Co., Inc., Philadelphia, Pa. They are not an adaptation from planer design, but are made from entirely new patterns and designed to resist the strains due to milling rather than planing.

The machine, shown in the illustrations, will take work 64 in. wide between the cutters on the side heads, 60 in. between the table and the cutters on the cross rail heads and will mill work 20 ft. long.

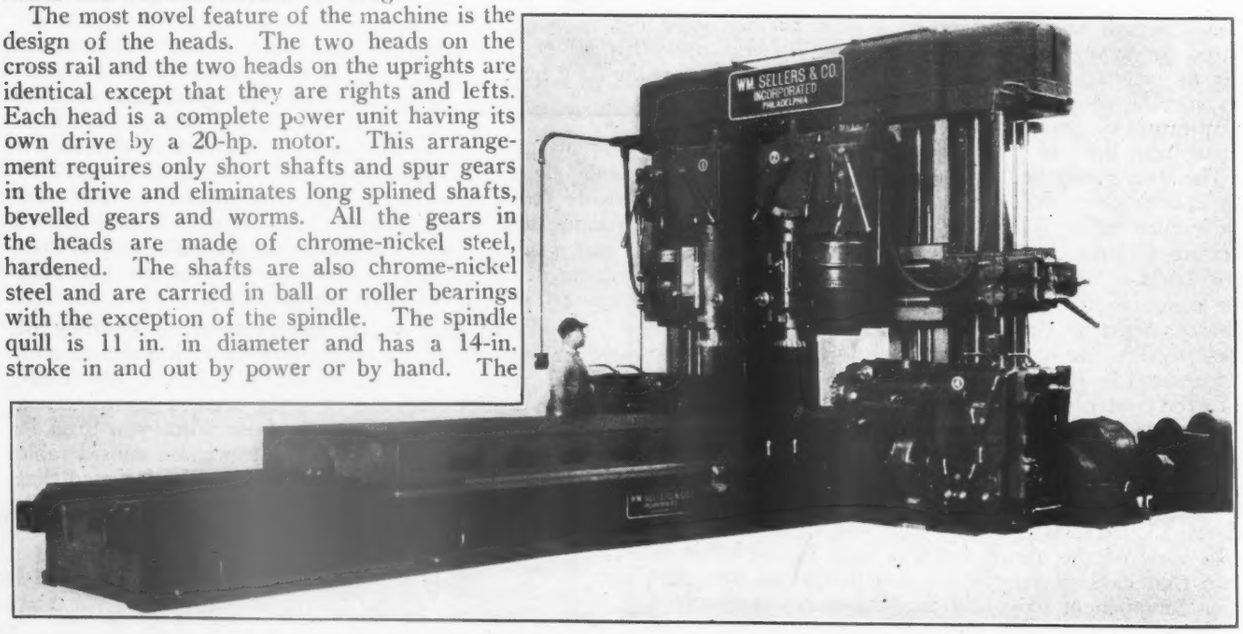
The most novel feature of the machine is the design of the heads. The two heads on the cross rail and the two heads on the uprights are identical except that they are rights and lefts. Each head is a complete power unit having its own drive by a 20-hp. motor. This arrangement requires only short shafts and spur gears in the drive and eliminates long splined shafts, bevelled gears and worms. All the gears in the heads are made of chrome-nickel steel, hardened. The shafts are also chrome-nickel steel and are carried in ball or roller bearings with the exception of the spindle. The spindle quill is 11 in. in diameter and has a 14-in. stroke in and out by power or by hand. The spindle is 6 in. in diameter at the small end of the tapered front bearing and is made from a chrome-nickel-steel forging. In the slow speed, it is driven by a gear 16 in. in diameter, through multiple splines milled into the spindle.

The feed for the heads is driven by an independent motor with a speed-reducing box, including one change of gears, and is located at the right side of the upright. All feeds from 1 to 16 in. per minute, are controlled by a field rheostat so that small variations in the amount of feed may be obtained.

The table feed has an independent motor and gear unit providing 1 in. to 16 in. per minute with a 20-ft.-per-minute rapid traverse. The variations are controlled by a field rheostat and one gear change.

Separate motors for the feeds are of advantage in milling irregular shapes as one feed may be started and stopped without interfering with the other and any combination may be employed to give any angle required. To mill the edges of irregular castings, the operator can vary the feeds to follow around the contour, without moving from the operating position, entirely by the use of field rheostats and push buttons.

An auxiliary motor mounted on the top of the machine provides power traverse for the heads and quills. Here again the machine is arranged for convenience, as one head may be traversed while another

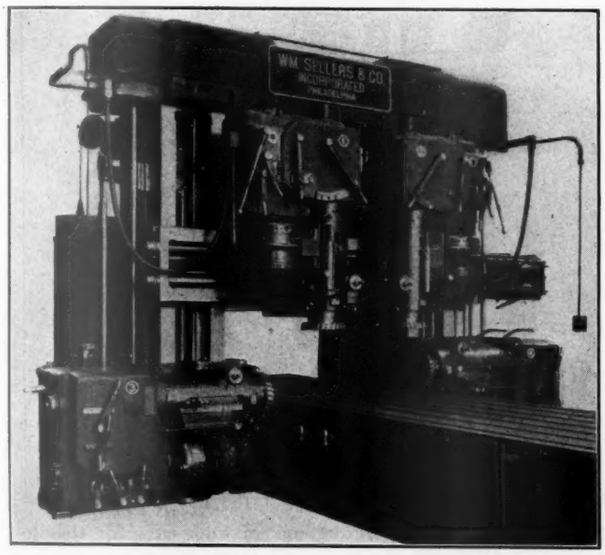


The Sellers 64-in. by 60-in. planer-type milling machine

is being fed. This motor also raises and lowers the cross rail. It is located half way between the two uprights so that there will be the same length of shaft running to each lifting screw, insuring steady and accurate lift.

The cross rail is of the box type with the back extended between the uprights. The cross rail slides not only on the face of the uprights but has a bearing on a vee at the back. A powerful clamp is provided and may be operated by a single lever at the end of the cross rail. This ties the uprights together, and provides the advantages of a fixed cross rail with the convenience of an adjustable cross rail.

The table is of deep box construction provided with



Front view of the Sellers milling machine, showing the motors for each milling head

T-slots and stop holes. It is carried on one flat and one double vee way. The double vee construction maintains accuracy under the heaviest side cuts. It consists of a flat vee combined with a vee with walls inclined a very few degrees from the vertical. The table bears on the flat vee except in cases of excessive side pressure when the upper vee holds the table from moving out of place. When there is no side thrust the upper vee clears by a few thousandths of an inch. Holding-down shoes are provided to keep the work table from lifting on the heavy side cuts. The table is driven by a spiral pinion and rack through herringbone gears from the gear-change box. The end thrust on the driving shaft is taken on ball bearings adjustable from outside the bed where they are readily accessible. Oil is continually circulating through these bearings.

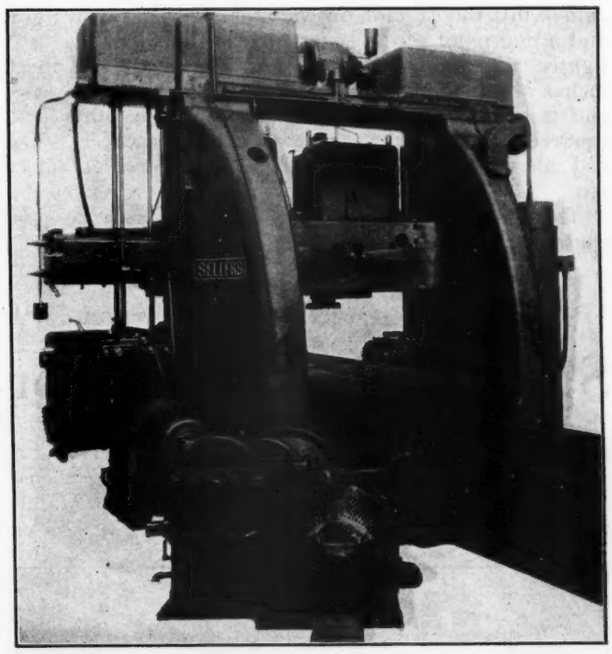
The bed is of the closed-top type and is heavily reenforced between the uprights. Inside the bed are located the tanks and pumps with their motors. This is a novel feature and eliminates piping which might be in the way and which would destroy the pleasing appearance of the machine.

The lubrication system has been carefully worked out. Each head has its own pump and circulating system. A pump is also provided in the feed-gear box to insure oil reaching all bearings and flowing over all gears. The table has forced-feed lubrication on the ways. The pump is run by a separate motor, so arranged that it must be started before the table feed motor can be started, thus insuring a supply of oil on the ways before any movement can take place. This pump also insures a continuous flow of oil through the spiral-pinion box and the driving-shaft bearings.

The overhead traverse and lifting mechanism, which does not require frequent oiling, is lubricated by pumps placed near the operating position where they may be worked periodically.

All of the motors are controlled from one panel and operated by push buttons located on both sides of the table. Interlocks are provided for the various motions. For example, the feed motors cannot be started until the cutter motors are in motion. If a 30 per cent overload occurs on any one of the cutter motors, the feed motors will slow down until the load is lessened when they will automatically speed up again. If a 50 per cent overload occurs on any one cutter motor, the overload relay will stop it and the feed motors will stop instantly.

A stainless steel scale is provided on each one of the heads graduated in 1/32 in. An adjustable pointer moves with the spindle and measurements may be read accurately on the scale. For closer readings it is so arranged that an indicator may be made to move with the quill and, by contact with a block located on a pad on the head, thousandths of an inch or less may be



A rear view showing the motor which drives the table

measured. The table is provided with a stainless steel scale and an adjustable vernier allowing readings to 1/64 in.

Provision is made for cutting compound. The tank is located in the bed and has a gage glass on the outside. The pump is driven by a 1-hp. motor forcing the liquid in pipes through uprights to the top of the machine, from where it runs through pipes and flexible connections to each of the heads. An adjustable frame and two nozzles are provided for each cutter. The cutting compound draining off the work runs to the end of the table where it passes through strainers and into a trough running the full length of the bed. This trough returns it to the tank.

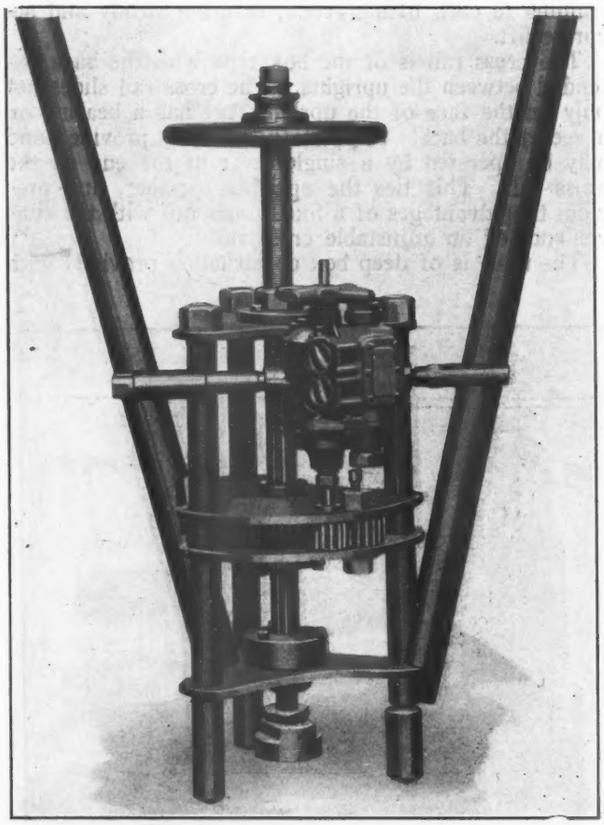
Tool for installing bottom outlet valve

THE tool illustrated was devised to make the installation of the Young tank car valve, manufactured by the Hills-McCanna Company, 2349 Nelson street, Chicago, a simple process in any tank car equipped with an outlet leg. The tool is placed inside the tank car and over the outlet. Two of the tool's three legs are placed on one side of the outlet parallel with the center line of the car, and the third leg, which is adjustable, is placed on the other side. This permits the tool to be leveled to the curve of the tank and allows the working side to face the tank end, giving room to properly operate the air motor and adjust the chuck.

After the tool has been centered, one of the long jack rods is placed on the bottom plate of the tool, between the two solid legs and up to the rivets of tank dome. The second jack rod fits against the adjustable leg and up to dome rivets. These are tightened so that the tool is solid. Then the chamber for the packing is drilled out and threaded. The tool is then removed and the Young valve installed.

Into the drilled chamber is first placed a lower metal packing ring and non-metallic packing, and, above this, an upper packing ring which is cut with a shoulder. Above this the cage of the valve is screwed down tight, and a dog point screw is set. Next the valve is closed tightly and the stem measured. It is cut off three inches above the brackets. The ends are squared; one end is swedged in the coupling and the other end squared and tapered to receive the handwheel. The rod above the wheel is drilled to receive a cotter pin.

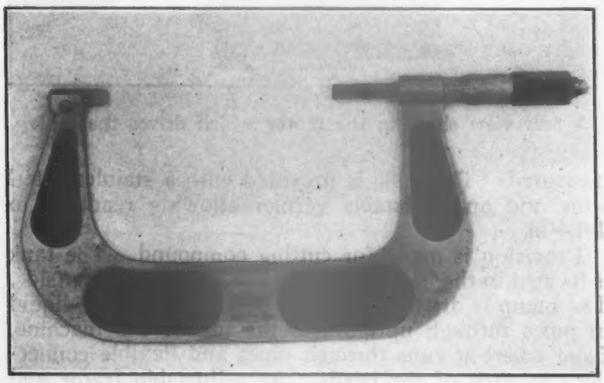
This tool and all necessary adjuncts may be purchased or rented.



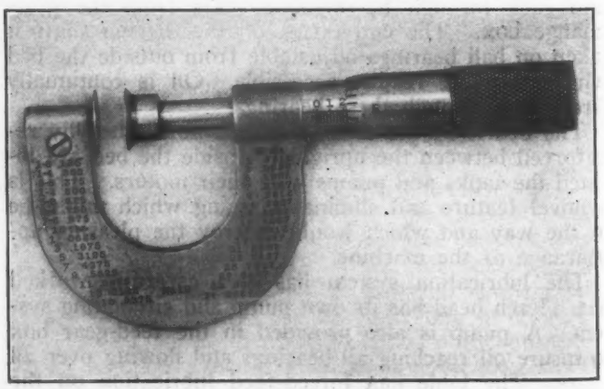
Tool for preparing the outlet legs of tank cars for the installation of the Young outlet valve

Special micrometers for measuring forming tools

TWO micrometer calipers, designed especially for the measuring of forming tools, has been placed on the market by the Brown & Sharpe Manufacturing Company, Providence, R. I. The disk-anvil type of micrometer for measuring the thickness of the forms is designed with special disks on the anvil and spindle end to take measurements on forming tools in places inaccessible to regular micrometers. The disks are ½ in. in diameter, 1/16 in. thick in the center and .020 in. thick at the outer edge. A measurement of a form up to ⅛ in. deep and over .020 in. in width can be taken. The caliper is made to measure only from zero to 1 in. by thousandths of an inch.



The blade-anvil micrometer for measuring the diameter of forming tools and the depth of narrow grooves

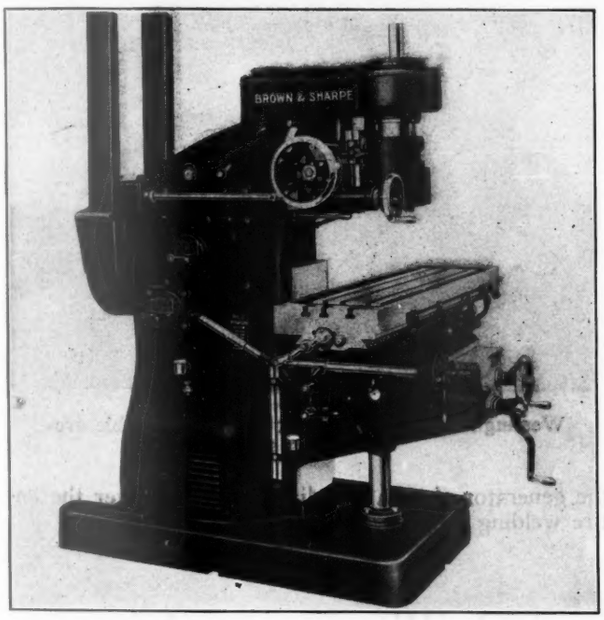


The disk-anvil type of micrometer for measuring the thickness of forms

The thin blade ends of the anvil and spindle of the blade-anvil micrometer caliper illustrated easily enter the narrow slots and grooves of the forming tools. The thin blades are .030 in. thick and permit measurements to be taken in slots or grooves having a depth up to 7/32 in. This type of micrometer is made in sizes measuring from 1 in. to 4½ in. by thousandths of an inch.

Standard vertical spindle milling machine

THE Brown & Sharpe Manufacturing Company, Providence, R. I., has recently announced the No. 2 standard vertical spindle milling machine as a further addition to its line of Standard milling machines. The machine is all-gear driven with anti-friction bearings from the driving pulley to the spindle and in the feed and power fast travel mechanisms. Two operating positions are provided, one at the front and one at the rear of the table, with all levers controlling



The Brown & Sharpe standard vertical spindle milling machine

the operation of the machine readily available from either position. Dual control for feed changes, a lever at the front of the table and one at the rear, facilitate feed changes being conveniently accomplished. Speed changes in two series are made by a single lever at the side of the machine. The rates of feed or speed for which the machine is set are indicated by direct reading dials located above the control levers. The machine is equipped with a power fast travel for longitudinal, transverse and vertical movements, operated by a single lever.

One of the important features of this machine is the automatic disengagement of the power fast travel and simultaneous engagement of the cutting feed without any attention on the part of the operator. This feature makes possible a considerable saving in the operator's time, as the work can be run up to a point close to the cutters before the cutting feed is engaged. It also prevents injury to the work and cutters through accidentally jamming the work into the cutters.

Automatic lubrication with filtered oil is provided for all mechanisms within the column and the driving pulley. Automatic oiling is also provided for the knee assembly, a separate pump being installed in the knee for this purpose. A single oil well lubricates the saddle and table bearings.

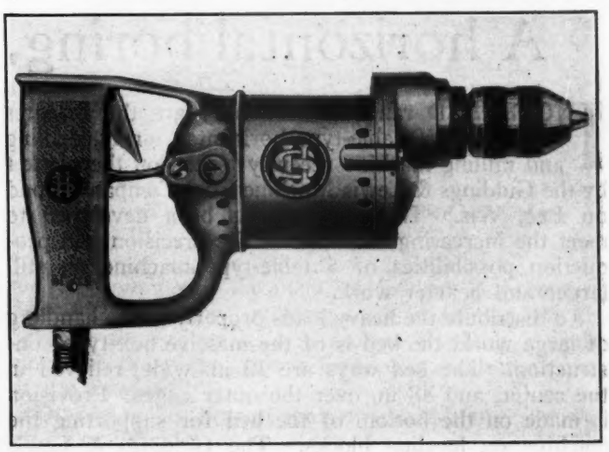
The knee-elevating screw is one piece, does not extend below the base of the machine and is completely guarded in all positions.

An automatic feed is provided for the spindle, which can be readily controlled from either operating position. It is provided with an automatic release at any point. The spindle is protected with a telescopic guard. The spindle head is counterbalanced and has a micrometer stop for controlling depth of cut.

The machine is available either as belt drive, fitted for a motor, or equipped with a motor. When motor driven, the motor is located in a well-ventilated compartment in the base and drives by chain and sprockets. The motor is mounted in such a manner as to be rigidly held in place, yet readily accessible. Adjustment of the tension in the driving chain is made by an adjusting screw located outside of the motor compartment. The entire drive, either by motor or belt, is adequately guarded.

High speed portable electric drill

TO meet the growing demand for a higher speed, light weight, ¼-in. portable electric drill, the United States Electrical Tool Company, Cincinnati, Ohio, has placed two designs on the market. The one design, designated as the ¼-in. special direct-drive drill, operates directly on the armature shaft at a speed of 10,000 r.p.m. and weighs only 4 lb. The other, designated as the ¼-in. special gear-reduction drill, operates at 2,000 r.p.m and is only ⅛ lb heavier.



The ¼-in. portable electric drill equipped with a keyless chuck

A keyless chuck has been added as a new feature of these drills. Another feature is the easy accessibility to close corners. Both drills use a universal motor that operates on direct current or alternating current of 60 cycles or less. They are equipped with SKF ball bearings throughout, double-silk-insulated enamelled armature wire, chrome-nickel-steel gears, one-piece frame and commutator head and a trigger switch.

A 200-ampere d. c. arc-welding set

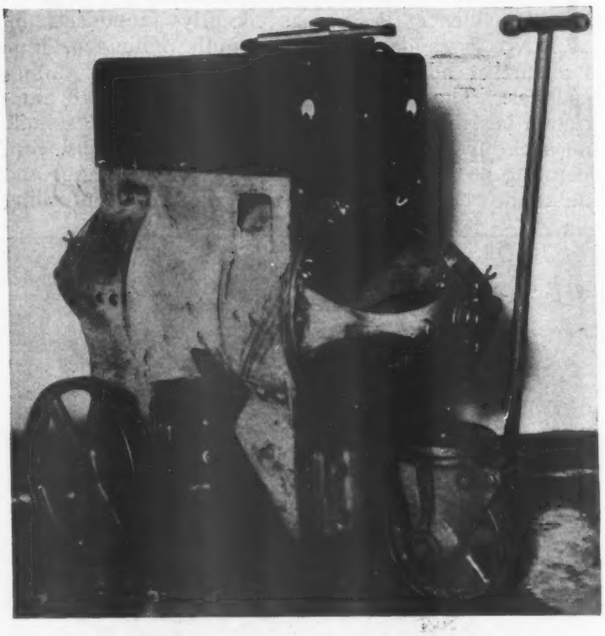
A RECENT development of the Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa., is a 200-ampere DC-DC welding set that has particular application in a railroad shop where only direct current is available for the driving motor of the welding set. It is designed so that either a 230- or 550-volt driving motor may be used. The construction is such that the set may be used either as a portable or stationary unit.

The driving motor and generator have a common frame and common shaft, supported by ball bearings. The control is mounted on the top as a part of the frame and is protected by a sheet steel cabinet. Three roller-bearing wheels, attached to the frame, make the set readily portable and give a welding machine with small overall dimensions and a low center of gravity. For stationary use, the running gear can be omitted.

The rating of the unit is in accordance with the N.E.M.A. standards of practice, which is 200 amp., 1 hr., 50 deg. rise in a resistance load at 25 volts. The welding range is from 60 to 300 amp.

The driving motor of the set, a special Type S.K., wound for either 230 or 550 volts, is compound wound and maintains constant speed with a voltage fluctuation of not more than 10 per cent. The motor-starting rheostat with low-voltage protection is enclosed and mounted in a sheet steel cabinet on top of the set.

A single-operator, constant-current, differentially compound-wound generator, separately excited from the motor supply line, is used. The field rheostat of the generator gives a one-dial adjustment over the entire welding range.



Westinghouse 200-amp. direct current portable arc-welding set

A horizontal boring, and drilling machine

INCREASED range and capacity are the features of the No. 50 table-type horizontal boring, drilling and milling machine recently placed on the market by the Giddings & Lewis Machine Tool Company, Fond du Lac, Wis. The machine has been developed to meet the increasing demand for the precision and production possibilities of a table-type machine on still larger and heavier work.

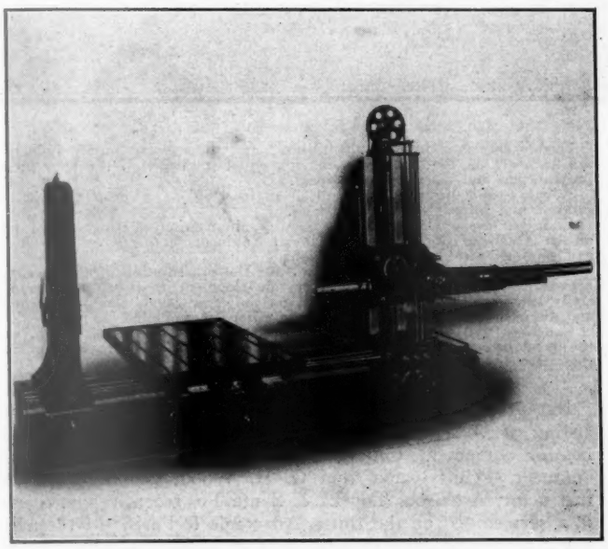
To distribute the heavy loads properly in the handling of large work, the bed is of the massive box-type construction. The bed ways are 13 in. wide, relieved in the center, and 48 in. over the outer edges. Provision is made on the bottom of the bed for supporting the machine on leveling blocks. The Giddings & Lewis feature of bolting, tonguing and doweling the column to the bed unit, has been employed on this machine. A large tongue is machined integral with the bed for this purpose. The column is a heavy box section, well ribbed in both directions, having a liberal spread, the base being 40 in. square.

The table and saddle unit is of the same general design as on the No. 45 machine, built by this company, but considerably heavier. To stiffen the table in every direction, it has been made practically a network of heavy ribbing. For adjustment between the table and saddle, two taper gibs are provided, one at each end. The screw for the cross feed of the table is mounted on ball bearings and arranged with adjustable graduated dials on either end. The Bowen system of lubrication is standard equipment for oiling all the ways, gears and bearings of this unit. One stroke of the plunger supplies the proper lubrication to all parts independent of the position of the table.

The spindle head is massively built and the main casting is entirely of one piece to furnish perfect and solid support to all moving parts. The head unit has been made as compact as possible so that it would not be an obstacle to the close observation of small work. This unit is automatically lubricated. A constant flow of oil is furnished to all parts by a pump located in the head.

The speeds and feeds are effected through sliding gears and jaw clutches in separate units mounted on the bed of the machine and running in oil. The changes in speed and feed are accomplished through levers easily accessible from the normal operating position.

All of the gears are of chrome-nickel steel, case hardened, with wide faces and with the teeth rounded to facilitate meshing. All the bevel gears in the speed train are of the spiral tooth form, giving a smooth quiet drive to the spindle. All the main shafts of the

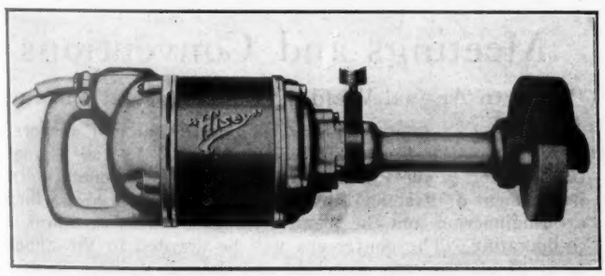


The Giddings & Lewis No. 50 table-type horizontal boring, drilling and milling machine

speed box are mounted in ball bearings. The power is furnished to the machine through two twin-disc friction clutches, which adapts the machine particularly well to tapping. A gear-change quadrant is included in the feed-gear train, so positive leads can be had for tapping and threading.

Portable combination grinder and buffer

A ½-hp. portable grinder and buffer, equipped with a ball-bearing motor and a Timken tapered roller-bearing grinding spindle, has recently been placed on the market by the Hisey-Wolf Machine Company, Cin-



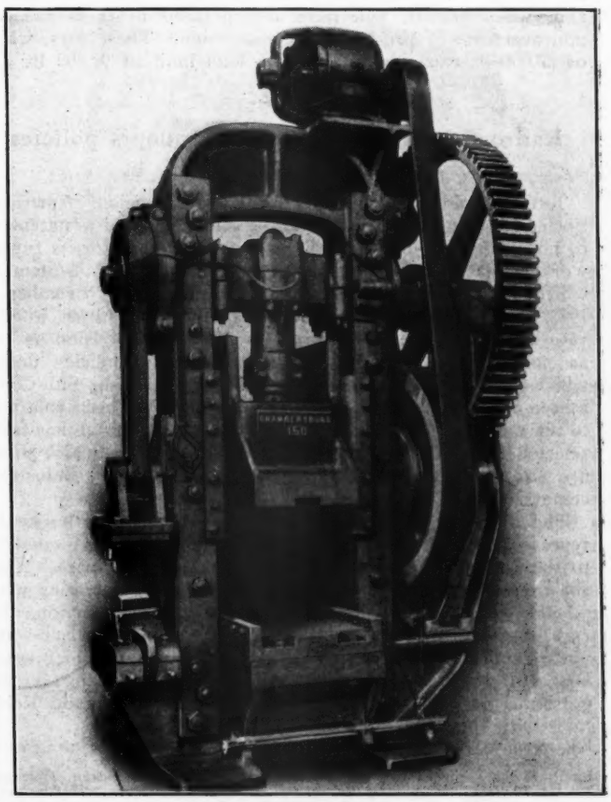
The Hisey-Wolf ½-hp. portable combination grinder and buffer

cinnati, Ohio. The grinder is made in both alternating-current and direct-current types. The alternating-current type has a speed of 3,425 r.p.m. under no load, and the direct-current type has a no-load speed of 3,550 r.p.m. Both types use 6½-in. by 1¼-in. grinding wheels with a ¾-in. hole. The net weight, with the guard in place, is 42 lb.

Trimming press with steel side frames

FORGED-STEEL side frames have been adopted for the new trimming press recently placed on the market by the Chambersburg Engineering Company, Chambersburg, Pa., with a view to eliminating side-frame breakage as a hazard of press operation. These side frames are strong I-section forgings, and are used in conjunction with a heavy semi-steel bed frame and yoke. Other features of the construction consist of the use of outboard bearings on all shafts and a patented friction-slip flywheel.

The flywheel is so designed as to prevent it from bursting and breaking the crank or gears when an overload stalls the press. The energy developed by the



Chambersburg trimming press equipped with steel side frames

sudden stopping of the machine, instead of expending itself by straining all moving parts, is released by the flywheel slipping on its hub against friction. Adjustments of the press are rarely necessary after slipping of the flywheel.

Other new features of the press include the provision of roller bearings on auxiliary shafts; directly renewable clutch jaws and cam; a pitman adjustment that grips threads the entire length of the screw; high-pressure grease lubrication of all bearings and contacting surfaces; improved method of clutch operation; easier operation of the treadle; reduced floor space requirements, and free accessibility of the machine from the rear. This press is supplied in either single or double-crank construction.

News of the Month

Central of New Jersey to rebuild cars

THE CENTRAL OF NEW JERSEY will rebuild 499 ice cars at its own shops. These cars, purchased in 1911 and 1916, have reached a period when it is necessary to give them general repairs. Instead of rebuilding them as ice cars for which there is little demand at the present time, the railroad has decided to rebuild them as single-sheathed box cars. They are equipped with all steel underframes, and cast steel trucks and, when rebuilt, will have incorporated in them modern improvements of present day construction. These cars, while of 80,000 lb. capacity, will carry a load limit of 92,400 lb.

Railroad Division, A. S. M. E. adopts policies for its activities

THE EXECUTIVE COMMITTEE, Railroad Division, American Society of Mechanical Engineers, recently adopted a statement of policies and objects to serve as a general basis for its future work and activities. These policies, according to a statement which was released by the committee on Monday, November 5, 1928, will be followed by the Executive Committee in the future conduct of the affairs of the Railroad Division as far as possible. In connection with the stated policies under which it is now operating, the Railroad Division, Sub-Committee on Relations with the Local Sections, has been enlarged to ten members. Each member of this sub-committee has been selected from A.S.M.E. local section territories in which there are one or more large railroad or railway supply industrial centers.

The members of this sub-committee have full authority to represent the Executive Committee in all matters of concern to the Railroad Division in their respective territories. This sub-committee has been assigned the work of co-operating with all the local sections, except the Metropolitan Section, the relations with which are taken care of by another sub-committee under the chairmanship of A. F. Stuebing, chief engineer, Bradford Corporation, New York. Following is the personnel of the Railroad Division, Sub-Committee on Relations with the Local Sections:

Eliot Sumner (chairman), assistant to general superintendent motive power, Pennsylvania, Broad Street Station, Philadelphia, Pa.
L. P. Michael, mechanical engineer, Chicago & North Western, Chicago.
T. C. McBride, consulting engineer, railroad department, Worthington Pump & Manufacturing Company, Philadelphia, Pa.
J. C. McCune, assistant director of engineering, Westinghouse Air Brake Company, Pittsburgh, Pa.
C. E. Barba, mechanical engineer, Boston & Maine, Boston, Mass.
E. D. Campbell, American Car & Foundry Company, St. Louis, Mo.
F. E. Russell, mechanical engineer, Southern Pacific, San Francisco, Cal.
George Hillyer, mechanical engineer, Southern, Washington, D. C.
Prof. A. J. Wood, Pennsylvania State College, State College, Pa.
D. W. Robertson, department of special development, National Malleable & Steel Castings Company, Cleveland, Ohio.

A new feature has been incorporated into the program of the Railroad Division, which the Executive Committee plans to make an annual event. The Railroad Division, Sub-Committee on Meetings and Papers, has culled the entire program of the society's annual meeting and is sponsoring a railroad program of 33 papers, only four of which are being presented by the Railroad Division. This program was published in the November issue of the *Railway Mechanical Engineer*.

Utilizing the annual meeting of the society as a national meeting, together with the National Exposition of Power and Mechanical Engineering, which is held during the same week in the Grand Central Palace, conforms to the policies and objects under which the Railroad Division is now operating. Following is part of the statement of policies and objects:

Maintain a professional division of the A. S. M. E. in which mechanical engineers employed in both the railroad and the railway supply industries are members on the same basis, having equal privileges of the floor in the presentation and discussion of papers.

Advance and promote mechanical engineering as a profession in the railroad and railway supply industries.

Endeavor to avoid, as much as possible, duplication of effort on the part of the American Society of Mechanical Engineers and the various official and semi-technical railway associations.

Afford a "technical clearing house" for the presentation of the mechanical engineering phases of proprietary development that can not be officially approved by the railroads, but, on the other hand, can be considered and discussed from a technical and professional standpoint.

Endeavor to obtain papers on advanced technical theories of design, etc., the development of which has not as yet reached the stage to warrant consideration in practical applications.

REPRESENTATIVES of the American Railway Association, consisting of W. H. Clegg, chief inspector of air brakes and car heating equipment, Canadian National; R. C. Burns, assistant engineer, Pennsylvania, and G. H. Wood, general air brake instructor, Atchison, Topeka & Santa Fe, recently participated in a service test on the Butte, Anaconda & Pacific of the automatic connector developed by the Consolidated Connector Corporation, Cleveland, Ohio, for automatically coupling air and steam hose between passenger and freight cars.

REPRESENTATIVES OF Germany's four leading locomotive plants who met recently to discuss the situation of the locomotive industry and to devise ways and means to improve it, have decided to enter into a working agreement for the purpose of promoting the interests of the German locomotive industry as a whole, according to a recent report made public by the Department of Commerce.

The agreement, in its present form, does not contemplate fusion or cartel measures of any kind. It is designed merely as an attempt to place the industry on a firm basis by limiting production to the requirements of the market. It is planned to stop locomotive production in the weaker plants by making it worth their while to turn to the manufacture of other products required by those engaged in the locomotive industry.

At present there are 21 locomotive factories in Germany, of which 20 are in operation. Their capacity exceeds the country's requirements by two-thirds and exports do not absorb anything like the surplus.

Meetings and Conventions

Fourth Annual Welding Conference at Purdue

PURDUE UNIVERSITY will hold its fourth annual conference on welding at Lafayette, Ind., December 12, 13 and 14, under the direction of the Engineering Extension Department and the Department of Practical Mechanics, with the School of Chemical Engineering and the manufacturers of welding equipment co-operating. The conference will be devoted to the applications of electric, oxy-acetylene and thermit welding to manufacturing and repair operations. Provisions will be made for exhibits and demonstrations.

The following list gives names of secretaries, dates of next or regular meetings and places of meeting of mechanical associations and railroad clubs.

AIR-BRAKE ASSOCIATION.—T. L. Burton, 165 Broadway, New York. Next meeting, April 30-May 3, 1929, at Stevens Hotel, Chicago.

AMERICAN RAILWAY ASSOCIATION DIVISION V—MECHANICAL.—V. R. Hawthorne, 431 South Dearborn St., Chicago. Annual meeting June, 1929, at Los Angeles, Cal.

DIVISION V.—EQUIPMENT PAINTING SECTION.—V. R. Hawthorne Chicago. Next meeting, September, 1929.

DIVISION VI.—PURCHASES AND STORES.—W. J. Farrell, 30 Vesey St., New York.

AMERICAN RAILWAY TOOL FOREMEN'S ASSOCIATION.—G. G. Macina, 11402 Calumet avenue, Chicago. Next meeting, September 11-14, 1929, Hotel Sherman, Chicago.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS.—Calvin W. Rice, 29 W. Thirty-ninth St., New York. Railroad Division, Marion B. Richardson, associate editor, *Railway Mechanical Engineer*, 30 Church St., New York.

AMERICAN SOCIETY FOR STEEL TREATING.—W. H. Eiseman, 7016 Euclid Ave., Cleveland, Ohio.

AMERICAN SOCIETY FOR TESTING MATERIALS.—C. L. Warwick, 1315 Spruce St., Philadelphia, Pa.

AMERICAN WELDING SOCIETY.—Miss M. M. Kelly, 29 West Thirty-ninth street, New York.

ASSOCIATION OF RAILWAY ELECTRICAL ENGINEERS.—Joseph A. Andrucetti, C. & N. W., Room 411, C. & N. W. Station, Chicago, Ill.

CANADIAN RAILWAY CLUB.—C. R. Crook, 129 Charon St., Montreal, Que. Regular meetings, second Tuesday in each month, except June, July and August, at Windsor Hotel, Montreal, Que. Next meeting December 10, 8:15 p. m. Paper on employee education will be read by H. J. Heisler, sleeping, parlor and dining car department, Canadian Pacific, Winnipeg. Address by Sir H. W. Thornton, president, Canadian National.

CAR FOREMEN'S ASSOCIATION OF CHICAGO.—G. K. Oliver, Chicago & Alton, Chicago, Ill. Regular meeting second Monday in each month, except June, July and August, Great Northern Hotel, Chicago. Next meeting, December 10, 8 p. m. Paper on how to reduce bad order cars will be read by K. F. Nystrom, superintendent car department, C. M. St. P. & P.

CAR FOREMEN'S ASSOCIATION OF ST. LOUIS.—A. J. Walsh, 5874 Plymouth Apt. 18, St. Louis, Mo. Regular meeting first Tuesday in each month, except June, July and August, at Broadview Hotel, East St. Louis, Ill.

CAR FOREMEN'S CLUB OF LOS ANGELES.—J. W. Krause, 514 East Eighth St., Los Angeles, Cal. Meeting second Friday of each month in the Pacific Electric Club building, Los Angeles, Cal.

CENTRAL RAILWAY CLUB.—H. D. Vought, 26 Cortlandt St., New York. Regular meetings second Tuesday each month, except June, July and August, at Hotel Statler, Buffalo.

CHIEF INTERCHANGE CAR INSPECTORS AND CAR FOREMEN'S ASSOCIATION.—See Master Car Builders' and Supervisors Assn.

CINCINNATI RAILWAY CLUB.—D. R. Boyd, 3328 Beekman St., Cincinnati. Regular meeting second Tuesday, February, May, September and November.

CLEVELAND RAILWAY CLUB.— F. L. Frericks, 14416 Adler Ave., Cleveland, Ohio. Meeting first Monday each month, except July, August and September, at Hotel Hollenden, East Sixth and Superior Ave.

INTERNATIONAL RAILROAD MASTER BLACKSMITHS' ASSOCIATION.—W. J. Mayer, Michigan Central, 2347 Clark Ave., Detroit, Mich. Next meeting, August 20-22, 1929, Fort Shelby Hotel, Detroit.

INTERNATIONAL RAILWAY FUEL ASSOCIATION.—L. G. Plant, Railway Exchange, 80 E. Jackson Boulevard, Chicago. 1929 Annual meeting Hotel Sherman, Chicago, May 7-10, inclusive.

INTERNATIONAL RAILWAY GENERAL FOREMEN'S ASSOCIATION.—William Hall, 1061 W. Wabash Ave., Winona, Minn.

LOUISIANA CAR DEPARTMENT ASSOCIATION.—L. Brownlee, 3212 Delachaise street, New Orleans, La. Meetings third Thursday in each month.

MASTER BOILERMAKERS' ASSOCIATION.—Harry D. Vought, 26 Cortlandt St., New York. Annual meeting May 21-24, 1929, Hotel Biltmore, Atlanta, Ga.

MASTER CAR BUILDERS' AND SUPERVISORS' ASSOCIATION.—A. S. Sternberg, master car builder, Belt Railway of Chicago, Chicago.

NEW ENGLAND RAILROAD CLUB.—W. E. Cade, Jr., 683 Atlantic Ave., Boston, Mass. Regular meeting second Tuesday in each month, excepting June, July, August and September, Copley-Plaza Hotel, Boston. Next meeting, December 11. Paper on Budget or allotment of railway purchases will be presented by D. C. Curtis, chief purchasing office, C. M. St. P. & P.

NEW YORK RAILROAD CLUB.—H. D. Vought, 26 Cortlandt St., New York. Meetings third Friday in each month, except June, July and August, at 29 Thirty-ninth St., New York.

PACIFIC RAILWAY CLUB.—W. S. Wollner, 64 Pine St., San Francisco, Cal. Regular meetings, second Tuesday of each month in San Francisco and Oakland, Cal., alternately.

RAILWAY CAR DEPARTMENT OFFICERS' ASSOCIATION.—See Master Car Builders' and Supervisors' Association.

RAILWAY CLUB OF GREENVILLE.— Paul A. Minnis, Bessemer & Lake Erie, Greenville, Pa. Meeting third Thursday of each month, except June, July and August.

RAILWAY CLUB OF PITTSBURGH.—J. D. Conway, 515 Grandview Ave., Pittsburgh, Pa. Regular meeting fourth Thursday in month, except June, July and August. Fort Pitt Hotel, Pittsburgh, Pa.

ST. LOUIS RAILWAY CLUB.—B. W. Frauenthal, M. P. O. Drawer 24, St. Louis, Mo. Regular meetings, second Friday in each month, except June, July and August.

SOUTHERN AND SOUTHWESTERN RAILWAY CLUB.—A. T. Miller, P. O. Box 1205, Atlanta, Ga. Regular meetings third Thursday in January, March, May, July, September and November. Annual meeting third Thursday in November, Ansley Hotel, Atlanta, Ga.

SOUTHWEST MASTER CAR BUILDERS' AND SUPERVISORS' ASSOCIATION.—See Master Car Builders' & Supervisors' Association.

TRAVELING ENGINEER'S ASSOCIATION.—W. O. Thompson, 1177 East Ninety-eighth St., Cleveland, Ohio.—Annual meting Hotel Sherman.

WESTERN RAILWAY CLUB.—W. J. Dickinson, 189 West Madison St., Chicago. Regular meetings, third Monday in each month, except June, July and August.

Supply Trade Notes

JOSEPH T. RYERSON & SON, INC., Chicago, has taken on the Millers Falls line of portable electric tools.

W. D. OTTER, with office in the Rialto building, San Francisco, Cal., has been appointed Pacific Coast representative of the Locomotive Finished Material Company, Atchison, Kan.

A. J. GATES, representative of the Baker-Raulang Company, Cleveland, Ohio, has been promoted to the position of chief sales executive.

THE ROSS HEATER & MFG. COMPANY, INC., has opened an office at 121 North Broad street, Philadelphia, Pa., under the direction of J. W. Spencer, Jr.

THE OHIO INJECTOR COMPANY, Wadsworth, Ohio, has opened a southwestern branch office at 908 Daniels building, Tulsa, Okla., with E. C. Powell in charge.

ARTHUR H. ABBOTT, INC., 88 Broad street, Boston, Mass., has been appointed district sales agent for the New England territory, of the Roller-Smith Company, New York.

W. D. OTTER, with office in the Rialto building, San Francisco, Cal., has been appointed Pacific Coast representative of the Electro-Motive Company, Cleveland, Ohio.

FREDERICK K. COPELAND, president of the Sullivan Machinery Company since 1892, died suddenly at Claremont, N. H., on November 10, following an attack of peritonitis.

THE STANDARD COUPLER COMPANY has moved its Chicago office from 122 South Michigan avenue to the State Bank building, La Salle and Monroe streets.

THE GENERAL AMERICAN TANK CAR CORPORATION, Chicago, has acquired the Buffalo Steel Car Company, Buffalo, N. Y., and will operate it as a subsidiary.

N. J. KAMEN, representative of the Detroit Lubricator Company, New York, has been appointed sales and service engineer in the railroad department of the Alemite Manufacturing Corporation, Chicago.

C. A. LIDDLE, vice-president of the Pullman Car & Manufacturing Corporation has been elected president, to succeed D. A. Crawford who has been elected executive vice-president of the Pullman Company.

VERNON C. WARD, formerly manager of sales of the steel construction department of the Jones & Laughlin Steel Corporation, has been appointed vice-president of the J. B. French Company, Chicago.

FRANK J. BAUMIS has resigned as president of the Shaw Crane-Putnam Machine Company, Inc., and as vice-president and director of Manning, Maxwell & Moore, Inc., to become associated with the Ingersoll-Rand Company, New York.

THE BOYE & EMMES MACHINE TOOL COMPANY, Cincinnati, Ohio, has appointed Knickerbock, Cram & Co., Inc., 7 East Forty -second street, New York, as agents for its line of lathes in the New York territory.

THE INDEPENDENT PNEUMATIC TOOL COMPANY, Chicago, will build an addition to its factory at Aurora, Ill. The new structure will consist of a modern, fireproof building of concrete construction and will add 36,000 sq. ft. to the present capacity.

R. J. WORKING, representative of the Central Alloy Steel Corporation, Masssillon, Ohio, has been promoted to district sales manager, with headquarters at Cincinnati, Ohio, to succeed J. D. Dearth, resigned.

S. W. PERRY, Monmouth, Ill., who formerly represented the DeVilbiss Company, Toledo, Ohio, has joined the sales organization of the Alexander Milburn Company, Baltimore, Md., to travel the middle western territory.

C. B. MOORE, vice-president of the Oxweld Railroad Service Company with headquarters at Chicago, has been elected chairman of the board. J. H. Rodger, formerly vice-president of the Safety Car Heating & Lighting Company has been elected vice-president of the Oxweld Railroad Service Company.

T. H. WILLIAMS has been appointed manager of railway sales of the Gunderson Process. This process is used for the prevention of pitting, grooving, and general corrosion in locomotive boilers, and is being manufactured and sold by the Electro-Chemical Engineering Corporation, 621 South Kolmar avenue, Chicago.

THE BOYE & EMMES MACHINE TOOL COMPANY, Cincinnati, Ohio, has appointed the Camm-Blades Machinery Company, 610 Michigan street, Milwaukee, Wis., as its agent in the Milwaukee territory. The Cadillac Machinery Company, 414 Fisher building, Detroit, Mich., represents the Boye & Emmes Company in the Detroit territory.

THE ASSOCIATION OF MANUFACTURERS OF CHILLED CAR WHEELS which held its annual meeting at the Congress Hotel, Chicago, on October 23, elected the following officers for the ensuing year: President and secretary, G. E. Doke; vice-presidents, J. A. Kilpatrick, W. C. Bickerman, D. H. Sherwood; treasurer, E. P. Ward and consulting engineer, F. K. Vial.

COMPLETING 20 YEARS of industrial cleaning service, the technical staff, field service men and executives comprising the organization of Oakite Products, Inc., met in the general offices at New York, November 14 to November 17, on the occasion of their annual sales conference. District managers and representatives from 33 states and Canada came together in daily discussion. One of the interesting phases of the convention was the demonstration of paint stripping on the side of a full-sized locomotive tender, the operation being performed by apparatus designed and built by the service department of Oakite Products, Inc.

RALPH K. WEBER has been elected president; Henry H. Cust, vice-president, and L. G. Sever, assistant to the president, of the Mt. Vernon Car Manufacturing Company, Mt. Vernon, Ill. Mr. Weber was born in Fairweather, Adams county, Ill., in 1868. After attending the Illinois State Normal University, Normal, Ill., he entered the employ of the Mt. Vernon Car Manufacturing Company in 1890 as a clerk to the superintendent, later serving as shipping and receiving clerk and chief clerk. From 1902 to 1908 he was secretary and in the latter year was promoted to vice-president. Mr. Cust was born in Allegheny, Pa., and entered business in 1880 as an iron broker at St. Paul, Minn. From 1884 to 1896 he was secretary of the Springfield Iron Company, Springfield, Ill., and from the latter date until 1903 was business manager of the New York Commercial, New York. In 1903 he became connected with the Lumber Mineral Company, Mt. Olive, Miss., and in 1918 became assistant to the president of the Mt. Vernon Car Manufacturing Company. In 1928 he was also elected vice-president of the J. P. Devine Manufacturing Company, Inc., at Buffalo, N. Y.

Ralph K. Weber

THE BUFFALO FORGE COMPANY, Buffalo, N. Y., is celebrating its fiftieth anniversary. In 1878 Charles F. Brunke and Chas. Hammelman, partners, began the manufacture of the portable forge originated by Mr. Hammelman, but after a year of disappointments sold to W. F. Wendt. In 1888 H. W. Wendt, a brother of W. F. Wendt, was admitted to the firm, and in 1903 the plants of the Geo. L. Squier Manufacturing Company and the Buffalo Steam Pump Company were acquired. In 1916 W. F. Wendt sold his entire interest to his brother, who then became president of the reorganized company.

WILLIAM MCBRIDE, president of the Fort Pitt Spring & Manufacturing Company, Pittsburgh, Pa., resigned as of October 31. Mr. McBride, who was the principal stockholder in the company, has sold his interests to Pittsburgh, New York, and Cleveland interests—Ralph H. Tate, Pittsburgh, Henry S. Sherman, Cleveland, and C. H. Collins, New York. The company is being continued as The Fort Pitt Spring Company. Mr. McBride was graduated as a civil engineer from the Rensselaer Polytechnic Institute, in the class of 1899, and has been identified with the spring industry since 1906.

JOHN K. SHAW, vice-president and director of the Celotex Company, was killed by the accidental discharge of his shotgun while duck hunting near Arlington, S. D., on November 2. He was born on August 3, 1872, in Dane county, Wis., and was educated at Poinette Academy in Wisconsin and the Northern Indiana College, Valparaiso, Ind. After completing his schooling he engaged in furniture manufacturing as a member of the firm of Peek, Dahlberg & Shaw, Minneapolis, Minn. In 1910 he became associated with B. G. Dahlberg, and from 1917 to 1921 was sales manager of the Insulite Company, Minneapolis. He was one of the organizers of the Celotex Company in 1920, being elected vice-president and sales manager. During the past year he relinquished his duties as sales manager in order to rest.

John K. Shaw

JAMES T. MILNER, vice-president of the Standard Car Truck Company, Chicago, died on November 19 at Coral Gables, Fla., from complications following a paralytic stroke. He was born on November 29, 1861, at Norwich, N. Y., and entered the employ of the Pullman Company in 1880. He was later promoted to assistant purchasing agent, which position he held until 1893 when he resigned to become western sales agent of the Pressed Steel Car Company, with headquarters at Chicago. From 1901 until 1904 he was engaged in the railway supply business. In 1908 he entered the employ of the Standard Car Truck Company as vice-president.

James T. Milner

H. E. CHILCOAT has been appointed manager of sales of the air dump car division of the Koppel Industrial Car & Equipment Company, with headquarters at Pittsburgh, Pa. Mr. Chilcoat was born in Orbisonia, Pa., and entered railroad service in 1900 as a machinist helper on the Pennsylvania at Pittsburgh. He served successively as work inspector, gang foreman and fore-

man of the air brake department until 1906, when he resigned to enter the employ of the Westinghouse Air Brake Company as traveling inspector, with headquarters at Richmond, Va. Subsequently, he was transferred to the sales department of that company at Pittsburgh and continued in sales work until 1918, when he resigned to become manager of the Clark Car Company. In 1926 he severed this connection and for the past two and one half years has been engaged in consulting commercial engineering work.

EGBERT HABBERTON GOLD, president of the Vapor Car Heating Company, Inc., Chicago, died at his summer home at Holland, Mich., on November 3, after an illness of four months. Mr. Gold was born in Cornwall, Litchfield county, Conn., on January 31, 1868, and graduated from Stevens Institute of Technology in 1889. He started in the car heating business with the Gold Car Heating & Lighting Company, and in 1903 established business under his own name. In 1906 he organized the Chicago Car Heating Company, of which he was the president until 1917, when the Chicago Car Heating Company and the Standard Heat & Ventilation Company, New York, combined and formed the Vapor Car Heating Company, of which company he was elected president.

Egbert H. Gold

WALTER L. CONWELL, president of the Safety Car Heating & Lighting Company, New York, has also been elected president of the Vapor Car Heating Company, Inc., Chicago., and the Vapor Car Heating Company of Canada, Ltd., to fill the unexpired term of Egbert H. Gold, deceased. Mr. Conwell was born at Covington, Ky., on January 25, 1877, and graduated from Manual Training High school, Philadelphia, and the engineering department of the University of Pennsylvania. He served with the Tennis Construction Company, railway contractors, and in 1898 was appointed chief engineer. From 1901 to 1911 he was a salesman with the Westinghouse Electric & Manufacturing Company. He then served until 1916 as president of the Transportation Utilities Company, dealers in railway supplies, and in 1916 was appointed assistant to the president of the Safety Car Heating & Lighting Company, and since 1919 has been its president. He is also chairman of the board of the Pintsch Compressing Company, president of the Safety Export Company and the Realty Securities Company, vice-president of the Ellcon Company and a director of the Standard Coupler Company and of the Vapor Car Heating Company.

Walter L. Conwell

CHARLES M. MUCHNIC, vice-president of the American Locomotive Sales Company at New York, has resigned.

Trade Publications

CRANES AND TROLLEYS.—Conco cranes and trolleys, designed for use in general manufacturing plants, structural shops, foundries, etc., where material handling is necessary are described and illustrated in catalogue No. 110 issued by H. D. Conkey & Company, Mendota, Ill.

"DON'TS FOR CUTTER GRINDERS.—This is the title of an eight-page illustrated brochure issued by Goddard & Goddard, Detroit, Mich. The booklet explains why one must know something of the structural changes of tool steel when subjected to the localized heat of a grinding wheel.

SIROCCO UNIT HEATERS.—Bulletin No. 7418 of the American Blower Corporation, Detroit, Mich., points out the characteristics and specifications of high and low pressure type Sirocco unit heaters for floor and ceiling applications. The construction and application of the heater is described and illustrated in detail.

BOWSER EQUIPMENT.—S. F. Bowser & Co., Inc., Ft. Wayne, Ind., describes and illustrates in a 72-page booklet a complete line of equipment for storing and dispensing gasoline, lubricating oils, paints, paint oils, burning oils, and other liquids (acids excepted). Particular attention is given to the application of this equipment to the railroad industry.

WATER SOFTENERS.—Crystalite is the subject of an illustrated bulletin No. 183 issued by the International Filter Company, 333 West Twenty-fifth Place, Chicago. The booklet, which contains 16 illustrated pages, discusses the chemistry of zeolite water softening, the early history and development of zeolite, the advantages of upflow softening illustrated with curves, the adaptability of crystalite to upflow softening, etc.

PATENTS.—Richards & Geier, 274 Madison avenue, New York, is distributing, free of charge, the fourth edition of "Patents—Law and Practice," which has been completely revised by one of the original authors, Oscar A. Geier, in an endeavor to give up-to-the-minute information to lawyers, manufacturers, merchants, and those generally interested in the subject of inventions and trade marks, both in the United States and foreign countries.

MCCROSKY COST-CUTTING TOOLS.—Catalogue No. 11 of the McCrosky Tool Corporation, Meadville, Pa., is an illustrated book of 64 pages, divided into three sections, the respective sections describing McCrosky super adjustable reamers, Ideal machine reamers, floating holders for reamers, taps, etc.; Wizard quick change chucks and collets and friction safety tap holders, and time-savers for engine lathes, including turrets, steadyrests and face plates.

THREAD-CUTTING DIE HEADS.—Chapters on the Land-Matic head for turret lathes and screw machines, the Landex head for automatic screw machines, the Lanco head for automatic, semi-automatic and hand-operated threading machines, and Victor taps comprise catalogue No. 30 of the Landis Machine Company, Waynesboro, Pa. Two other catalogues describe Landis pipe threading machines, pipe threading and cutting off machines and pipe and nipple threading machines.

SAW SHARPENING AND KNIFE GRINDING.—Two booklets descriptive of saw sharpening and knife grinding in southern and western saw mills have been prepared by the Norton Company, Worcester, Mass. In these booklets the more common and important factors that, in addition to the different saw steels or the grinding wheel itself, affect wheel action are pointed out and discussed, and specific recommendations given for each of eleven types of work under which grinding wheels may be classified.

Personal Mention

General

J. A. ANDERSON, shop superintendent of the Chicago, Milwaukee, St. Paul & Pacific at Milwaukee, Wis., has been promoted to assistant superintendent of motive power, in charge of shops and machinery for the system.

G. R. WHISLER, superintendent of the Chicago, Springfield & St. Louis and the Jacksonville & Havana, has been appointed superintendent of motive power, with headquarters as before at Springfield, Ill.

THOMAS W. CARR, chief draftsman to the mechanical engineer of the Pittsburgh & Lake Erie, has been appointed mechanical engineer, with headquarters at Pittsburgh, Pa., succeeding Charles H. McConnell, deceased. Mr. Carr was born at Carnegie, Pa., on November 13, 1892, and was educated in the public schools of that city, and also attended the Carnegie Institute of Technology at Pittsburgh. He entered the service of the Pittsburgh & Lake Erie on February 1, 1911, as a machinist apprentice. He completed his apprenticeship on December 1, 1915, and served as a machinist until January 1, 1917, when he was promoted to shop draftsman and apprentice instructor. On January 1, 1920, he became mechanical estimator, and on September 1, 1920, was appointed chief draftsman to the mechanical engineer.

T. W. Carr

Master Mechanics and Road Foremen

GEORGE SCHEPP has been appointed master mechanic of the Wichita division of the Missouri Pacific, with headquarters at Wichita, Kan., succeeding J. B. Crahan.

J. B. CRAHAN, master mechanic of the Missouri Pacific at Wichita, Kan., has been transferred to the Memphis and Little Rock divisions, with headquarters at McGehee, Ark., to replace W. A. Curley, deceased.

F. D. SMITH, traveling fireman on the Manitoba district of the Canadian National, with headquarters at Sioux Lookout, Ont., has been promoted to master mechanic at Rainy River, Ont.

WARREN D. GOCHENOUR has been appointed master mechanic of the Rocky Mountain division of the Northern Pacific, with headquarters at Missoula, Mont., succeeding Sutton H. Draper, who retired on November 1 after 45 years of continuous service with that railroad.

THE JURISDICTION OF P. L. Mullen, master mechanic of the Illinois division of the Chicago, Milwaukee, St. Paul & Pacific, with headquarters at Savanna, Ill., has been extended to include the Dubuque division.

R. C. HEMPSTEAD, master mechanic of the Dubuque division, of the Chicago, Milwaukee, St. Paul & Pacific, at Dubuque, Ia., has been promoted to shop superintendent with headquarters at Milwaukee, Wis., succeeding J. A. Anderson.

Car Department

E. F. DAVIS, general car foreman of the Baltimore & Ohio at Cumberland, Md., has been transferred to Pittsburgh, Pa.

ARTHUR H. KEYS, general car foreman of the Baltimore & Ohio, at Baltimore, Md., has been transferred to Cumberland, Md., succeeding E. F. Davis.

CARL W. FREY, superintendent of shops of the Michigan Central at Detroit, Mich., has been promoted to master car builder, with headquarters in the same city. Mr. Frey has been in the service of the Michigan Central for about 16 years. He was born on March 11, 1888, at Sandusky, Ohio, and is a graduate of the high school of that city, entering railway service in June, 1902, as a laborer and material carrier on the Lake Shore & Michigan Southern (now part of the New York Central). During 1904 he was employed as a clerk and stock keeper and for the following 11 years he served successively in the car repair department of the L. S. & M. S., as a piece work inspector of the Lake Erie & Western (now part of the New York, Chicago & St. Louis), as general work inspector of the Wheeling & Lake Erie and the Michigan Central, and as chief contract inspector on the latter road. In October, 1916, Mr. Frey became assistant general foreman of the Michigan Central and general foreman in August, 1917. He was promoted to superintendent of shops at West Detroit, Mich., in February, 1922.

Purchases and Stores

FRANK COOPER has been appointed assistant purchasing agent of the Canadian Pacific, with headquarters at Vancouver, B. C.

R. J. WHITE has been appointed purchasing agent of the Canadian Pacific at Calgary, Alta.

J. ARNOTT has been appointed assistant purchasing agent of the Canadian Pacific, with headquarters at Calgary, Alta.

W. T. PLUMB has been appointed assistant purchasing agent of the Canadian Pacific, with headquarters at Winnipeg, Man.

W. J. BURNS has been appointed assistant purchasing agent of the Canadian Pacific, with headquarters at Montreal, Que.

R. H. YARNELL has been appointed assistant purchasing agent of the Canadian Pacific, with headquarters at Quebec.

JOHN EATON has been appointed assistant to the general purchasing agent, of the Canadian Pacific, with headquarters at Montreal, Que.

E. C. P. CUSHING, purchasing agent of the Canadian Pacific at Calgary, has been transferred in the same capacity to Vancouver, B. C.

T. M. McKeown, purchasing agent of the Canadian Pacific at Vancouver, B. C., has been appointed assistant general purchasing agent, with headquarters at Montreal, Que.

Obituary

WILLIAM A. CURLEY, master mechanic of the Little Rock division of the Missouri Pacific, with headquarters at McGehee, Ark., died in the Missouri Pacific hospital at St. Louis, Mo., on October 27, following a protracted illness.

GEORGE THOMPSON, who was master mechanic of the Union Pacific at Omaha, Neb., from 1903 to 1906, and superintendent of motive power of the Denver, Northwestern & Pacific (now the Denver & Salt Lake), with headquarters at Utah Junction, Colo., from 1906 to 1913, died at Los Angeles, Cal., on June 27 following an illness from acute indigestion. Since 1913, Mr. Thompson had been with the Oxweld Railroad Service Company, and at the time of his death he was district superintendent at Los Angeles.

Railway Mechanical Engineer

VOLUME 102, NUMBER 12 — New York—December, 1928—Chicago — ESTABLISHED 1832

HOW MUCH ? BETTER

IS THE SYMINGTON DOUBLE TRUSS SIDE FRAME

STUDY THE RESULTS OF

COMPARATIVE TESTS

PAGES 66 & 67

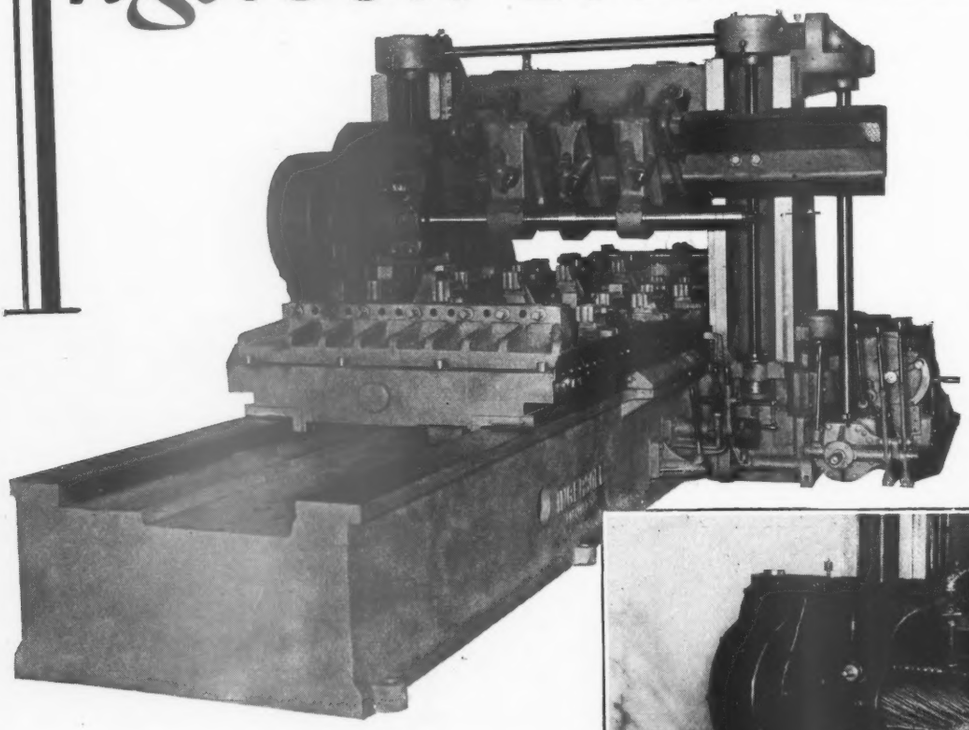
1. INCREASED SPRING CAPACITY.
2. GREATER STATIC STRENGTH.
3. HIGHER RESISTANCE TO FATIGUE.
4. LESS DEFLECTION AND SET.
5. GREATER BOLSTER STABILITY.
6. ALL A. R. A. COILS—ON THE SAME LEVEL.
7. DECREASED WEIGHT.

THE GOULD COUPLER CO.

NEW YORK CHICAGO BALTIMORE ST. LOUIS

Works: Depew, N. Y. SAN FRANCISCO Adanac Supplies, Ltd., Montreal

Ingersoll Rod Machine

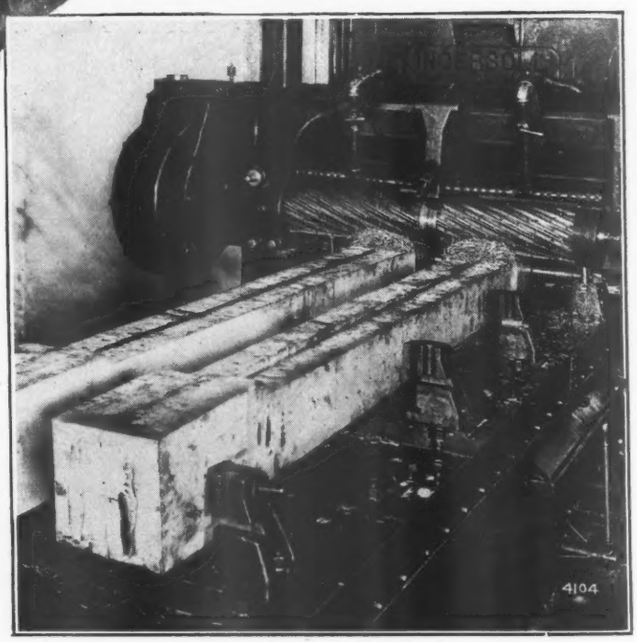


The Ingersoll Inclined Rail Milling Machine is so widely used and has proved so successful for rod milling that it is practically a standard for that class of work.

The 75 horsepower machine illustrated will accommodate a pair of rods, up to 24 inches wide. The Ingersoll universal rod fixtures shown on the machine hold any rod securely for slabbing, channeling or edging, and greatly increase the efficiency of the machine by reducing set-up time.

Ingersoll slabbing and channeling cutters give a good finish under heavy cuts at unusually high feeds. The combination of machine, fixtures, and cutters, built by the same organization for use together, is one that is unexcelled.

Ingersoll equipment for railroad shops is fully described in Bulletin No. 46, which will be sent on request.



Four main rods being edged on an Ingersoll. The cutters are Ingersoll 9"x24" helical inserted tooth slabbing cutters. The rods are held in Ingersoll fixtures. Note the absence of interference from clamps.

The Ingersoll Milling Machine Co.

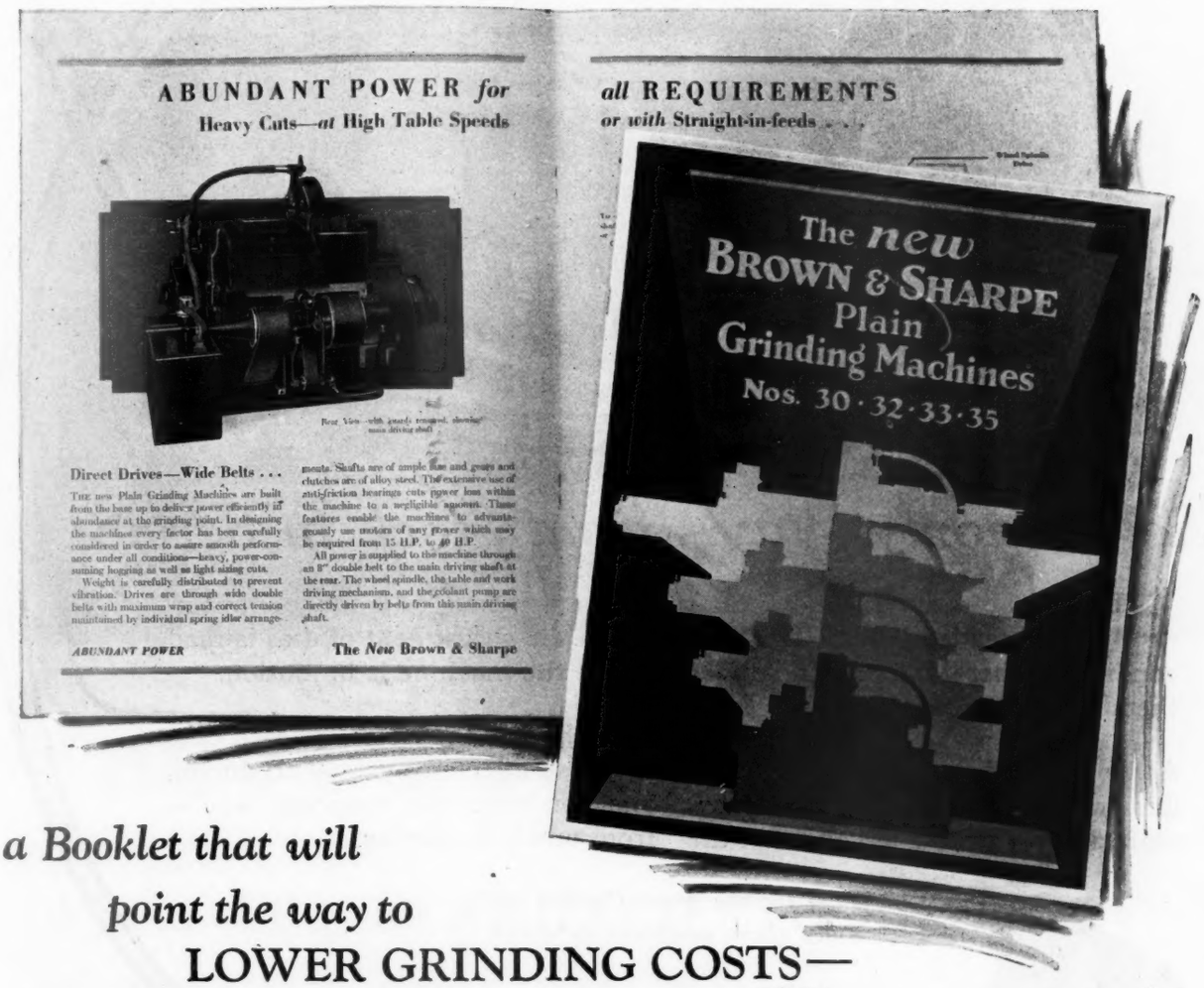
MILLING MACHINES AND THEIR EQUIPMENT

Rockford, Illinois, U.S.A.

Vol. 102 Number 12

Published monthly by Simmons-Boardman Publishing Company, 34 North Crystal Street, East Stroudsburg, Pa. Entered as second class matter, March 10, 1928, at the post office at East Stroudsburg, Pa., under the act of March 3, 1879.

. . NOW READY!



a Booklet that will point the way to LOWER GRINDING COSTS—

THIS booklet, which describes the outstanding features of the new Brown & Sharpe Plain Grinding Machines, should be in the hands of everyone interested in an advanced standard of performance for his production grinding department.

Many of the features described are entirely new,—the results of the effort of Brown & Sharpe engineers to design machines that will meet future requirements as well as today's demand for better grinding.

If you have not already received a copy, write for one today. Specifications of any particular size in which you are interested will be included with the booklet at your request.

No. 30 (12″ x 18″)
No. 32 (12″ x 36″)
No. 33 (12″ x 48″)
No. 35 (12″ x 72″)

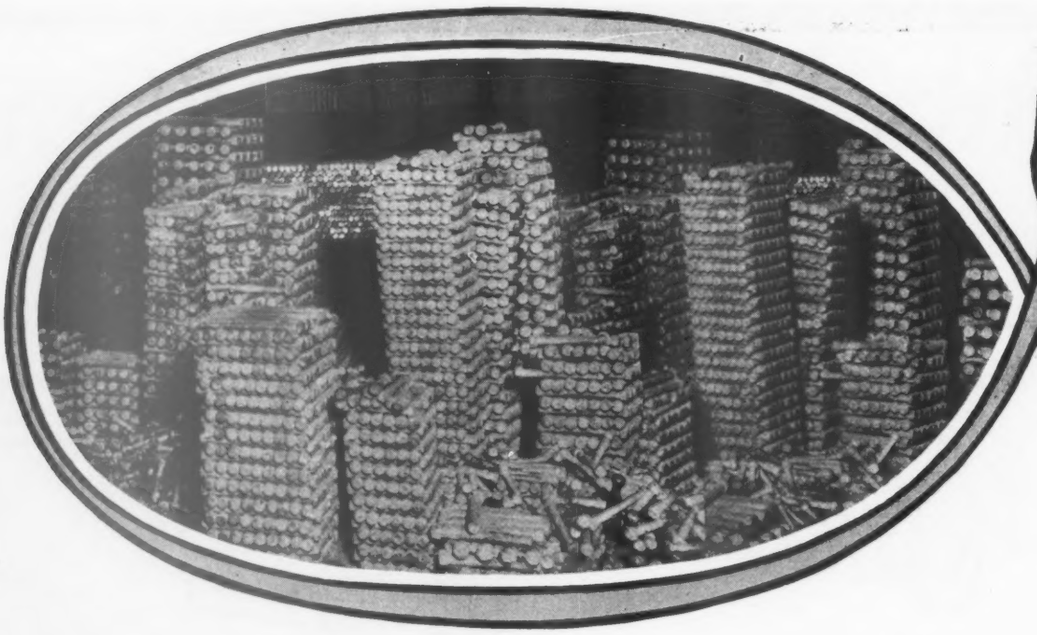
MODIFIED MACHINES

Nos. 30A, 32A, *and* 33A
(Power Table Feed for Wheel Truing, and Power Cross Feed)

Nos. 30B, 32B, *and* 33B
(Hand Table and Cross Feeds)

BROWN & SHARPE

BROWN & SHARPE MFG. CO. PROVIDENCE, R. I., U. S. A.



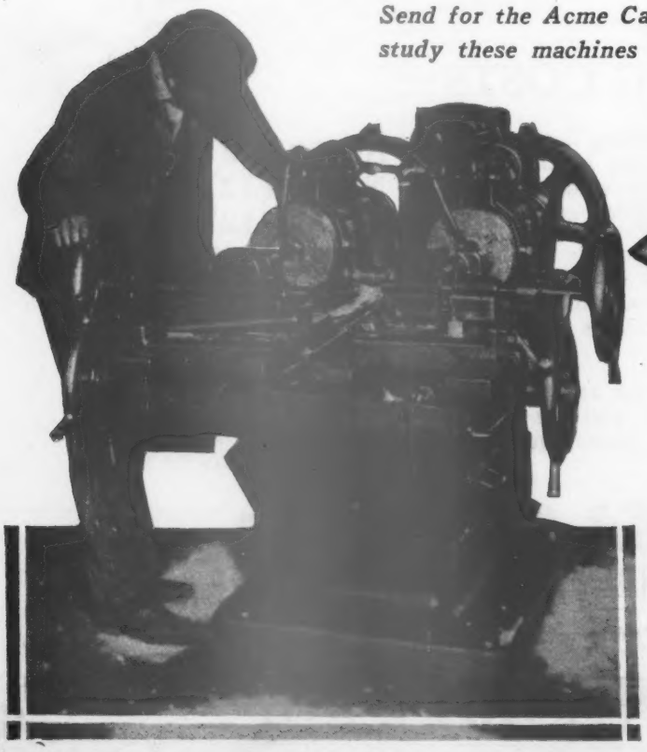
The Economy Way—from Stock to Service

BLANK bolts cost less to carry than threaded bolts. The ideal condition, therefore, is to thread them as they're needed.

Acme Threading Machines permit this practice because they are steady, swift and accurate and can meet the demands such a practice imposes. Even the adjustment of dies is made while the machine is in motion.

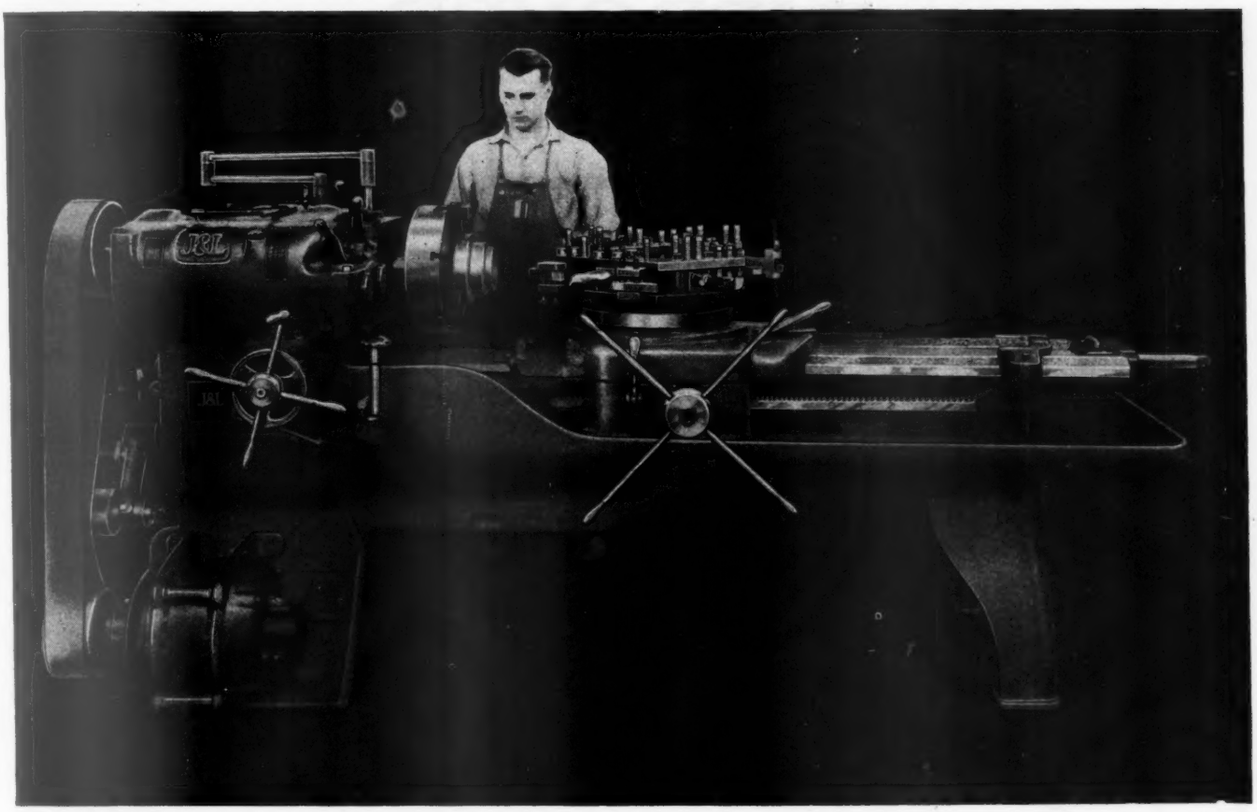
Add the savings of lower stock costs to those effected by fast production and you have "the economy way"—from stock to service.

Send for the Acme Catalog and study these machines in detail.



These bolts were forged on an Acme Forging Machine, details of which will also be sent on request.

THE ACME MACHINERY CO.
Cleveland Ohio



THE J & L TURRET LATHE

WITH ITS STANDARD TOOL OUTFIT IS READY FOR EVERY JOB — QUICK TO SET UP — ABLE TO TAKE HEAVY CUTS — ACCURATE IN DUPLICATION OF SIZES

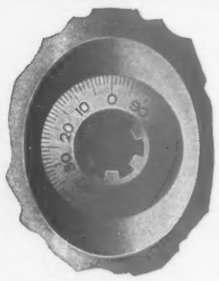
J&L
JONES & LAMSON

Jones & Lamson Machine Co.
Springfield, Vermont

J&L
JONES & LAMSON

IMPROVED

Davis Expansion Car Wheel Boring Tools

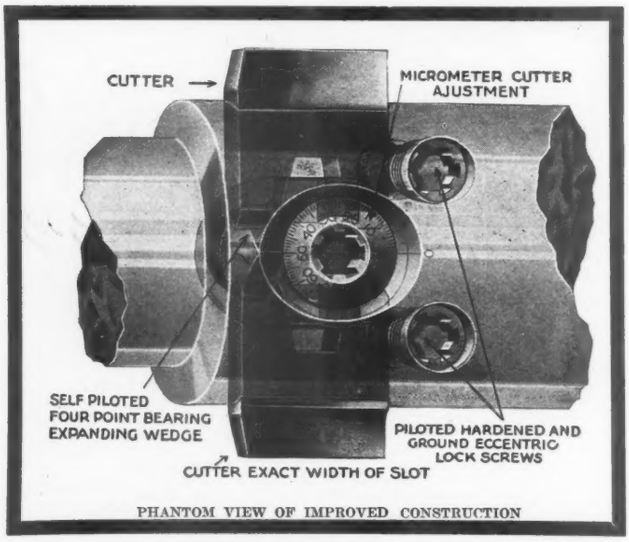


MICROMETER ADJUSTMENT TO EXPAND CUTTERS

DAVIS SPECIAL 2 in 1.

TOOLS ARE FURNISHED IN SEVERAL STYLES TO SUIT REQUIREMENTS OF ANY BORING MACHINE--FOR COMPLETE INFORMATION WRITE FOR CIRCULAR L2.

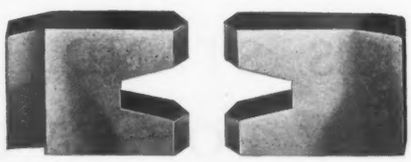
Increase Production & Reduce Cost


CUTTER
MICROMETER CUTTER AJUSTMENT
SELF PILOTED FOUR POINT BEARING EXPANDING WEDGE
PILOTED HARDENED AND GROUND ECCENTRIC LOCK SCREWS
CUTTER EXACT WIDTH OF SLOT

PHANTOM VIEW OF IMPROVED CONSTRUCTION

IMPROVED DAVIS TYPE "L" CAR WHEEL BORING TOOLS will greatly facilitate the boring and mounting of car wheels. Wheels can be bored to fit axles in the shortest time with positive accuracy. The importance of correct wheel boring and mounting cannot be over-estimated as it affects the efficiency of the car wheels and to a certain extent, the wear and upkeep of the rolling stock.

EXTRA CUTTERS



Better Cutters at Lower Cost

DAVIS CUTTERS are made of the very best High Speed Steel, guaranteed to be correct in every detail. They are specially formed, heat treated, tempered, and ground to meet the exact requirements for boring either Cast Iron or Steel Wheels. They insure the greatest production and maximum number of wheels per grind. Your cutter cost will be lowered and production increased through the use of Davis Cutters. They permit maximum speeds and feeds when rough boring, and, when finish boring, produce a smooth and accurately bored hole, enabling you to maintain uniform wheel fitting. Davis Cutters are carried in stock for immediate delivery.

Tools are made in special designs for Locomotive Shops. For complete information, write for Circular L-1 and L-3.

Davis Boring Tool Company
Incorporated

Division LARKIN PACKER COMPANY
6200 MAPLE AVE. ST. LOUIS, MO.

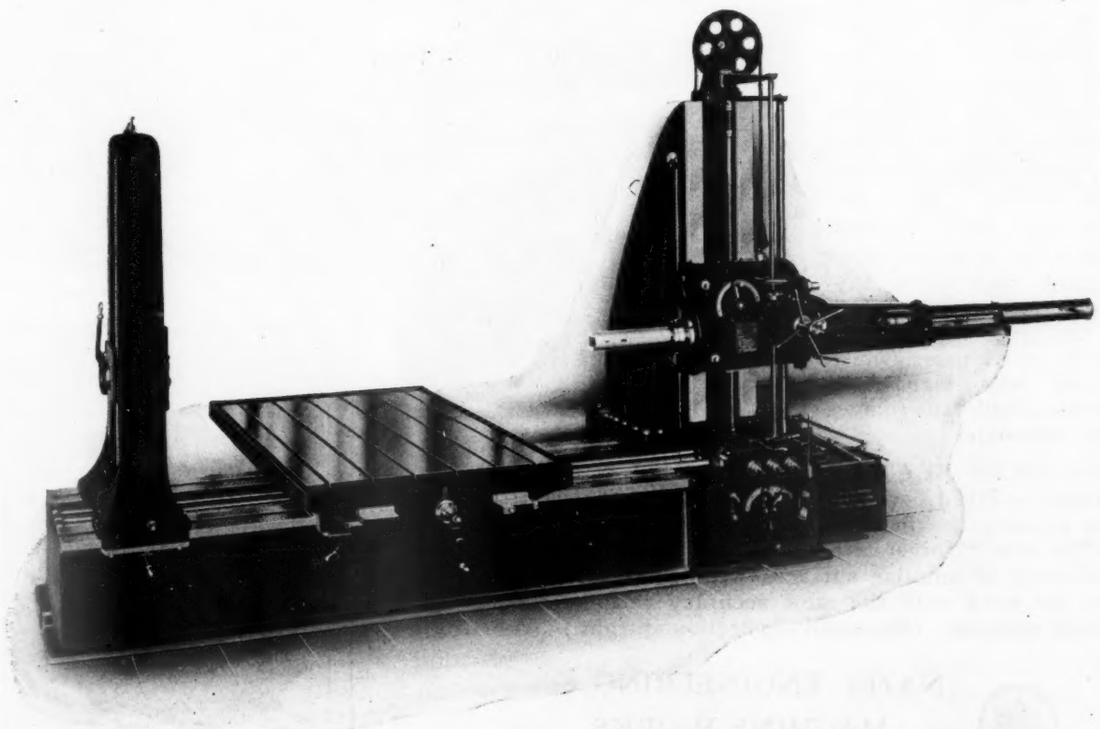
The G. & L. Method Widens its Field

With a New and Larger

Giddings & Lewis Table Type Horizontal Boring, Drilling & Milling Machine

The large range of this No. 50 offers the unusual in a table type machine. It combines the range of a 5" floor type machine with the precision and production possibilities of the table type machine.

A continuous automatic system of lubrication to all parts of the head and the Bowen system of lubrication for all bearings and sliding surfaces of the table and saddle unit are a few of the features. The weight of 45,000 pounds for the standard machine gives an idea of its size.



"Specialists in Horizontal Boring, Drilling and Milling"

GIDDINGS & LEWIS MACHINE TOOL CO.
Founded 1859
FOND DU LAC, WISCONSIN

Finishing-up Slide and Main Rods *is "only one" of many* Time and Labor Saving Jobs *which can be done by* THE DILL SLOTTER

ADDS a "Complete Department" to your Shop

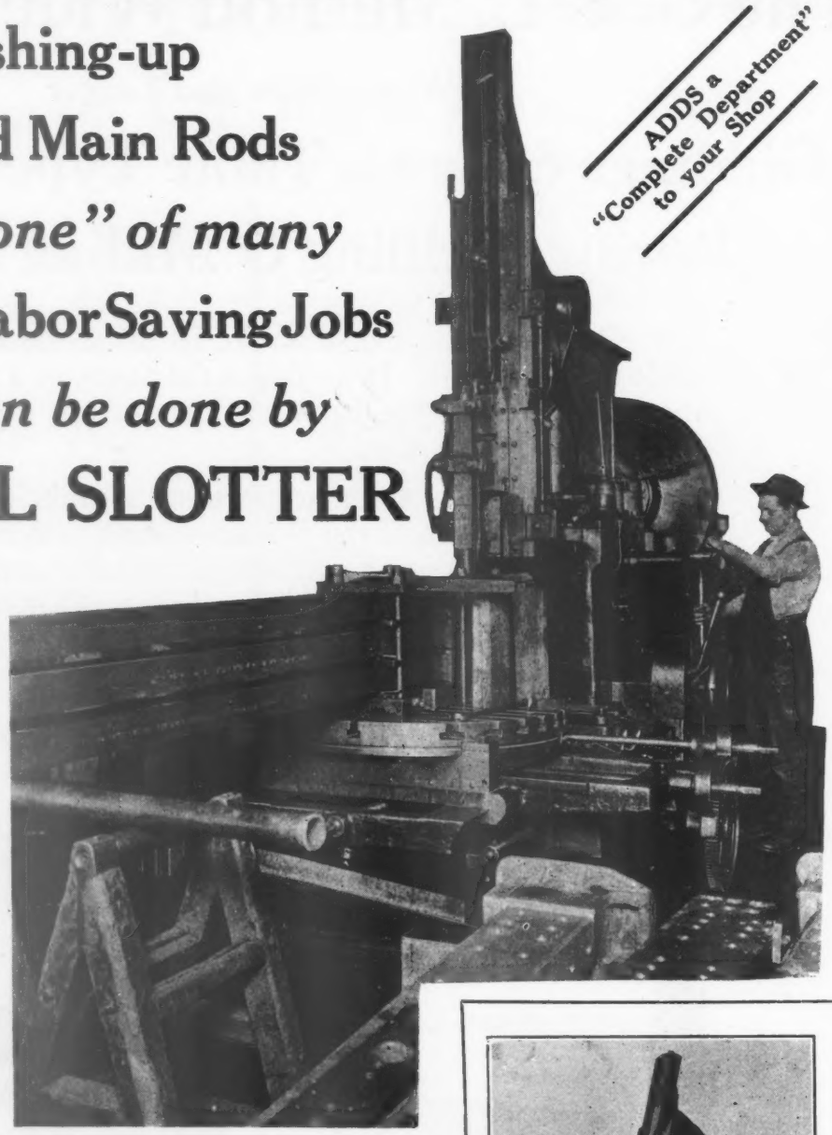


Illustration to the right shows the "DILL" Slotting 3 Main Rods in "one set-up." This is nothing unusual for the "DILL," but is merely an example of its usefulness and versatility in R. R. Shops.

Dill Slotters are Durable, Accurate and capable of handling a wide variety of work, both large and small.

That the DILL SLOTTER is an "extraordinary" machine and a "money-saver," is best attested to by the large number and quality of its users, which by the way, includes a number of railroads (names upon request).

EXCLUSIVE FEATURES of the DILL are: 1.—The "Traveling Head," which feeds the tool to the work and thus permits the machining of big, cumbersome parts. 2.—The new "Universal Swivel Head," which allows the machining of angular surfaces without re-setting,—and does the work with the same accuracy and speed as on straight surfaces. (See small illustration at right.)

NAZEL ENGINEERING & MACHINE WORKS

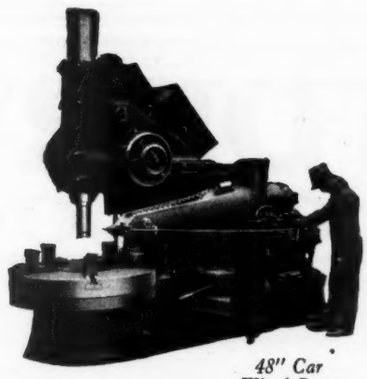
4043 N. 5th St., Philadelphia, Pa.

Also builders of the NAZEL Air Driven Forging Hammer.

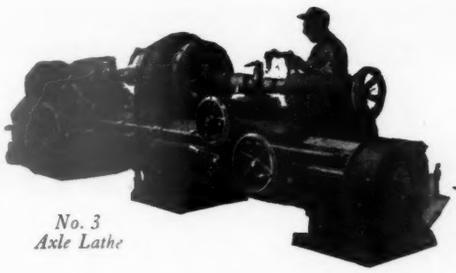
Nazel Engineering and Machine Works, 4043 N. 5th St., Phila., Pa.
Gentlemen: Please send me the "Dill Slotter Book" and full particulars.

Mr. ..... Title .....
Firm Name .....
Street ..... City ..... State .....

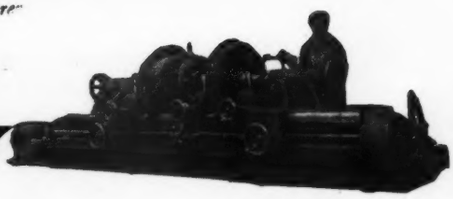
R 12-28



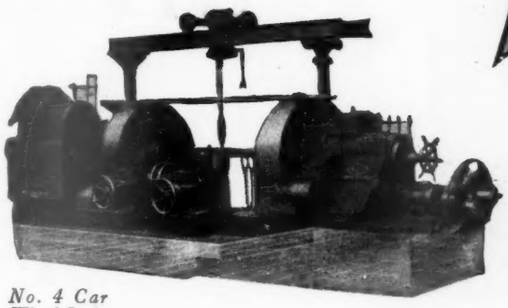
48" Car Wheel Borer



No. 3 Axle Lathe

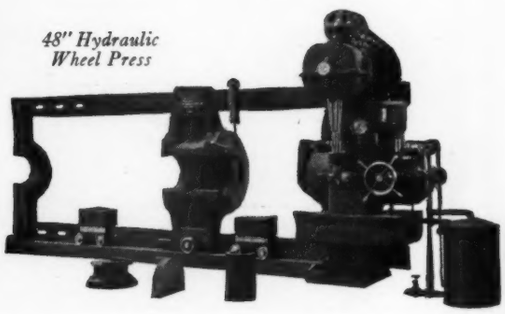


Combination Journal Turning & Axle Lathe



No. 4 Car Wheel Lathe

5



48" Hydraulic Wheel Press

STAR PERFORMERS

in the R. R. Car Shop

Here are some of the reasons why Niles Tools are lowering costs in the Wheel Shop.

The Niles Car Wheel Lathe is regularly producing 20 pairs of wheels in an 8 hour day. The Niles Car Wheel Borer averages 100 cast iron wheels (or a proportionate number of steel wheels) in an eight hour day. In one shop, two machines and one operator are producing from 260 to 275 cast iron wheels in a 10 hour day.

The production of the No. 3 Axle Lathe is easily 16 axles in an 8 hour day. In one shop the machine paid for itself in two years. As for the Combination Journal Turning and Axle Lathe, the average production is 21 pairs every 8 hours though in one shop they turned the journals of 34 pairs of wheels in 8 hours.

The 48" Niles Wheel Press presses off 18 to 20, or presses on 10 to 12 pairs of wheels an hour depending on shop conditions.

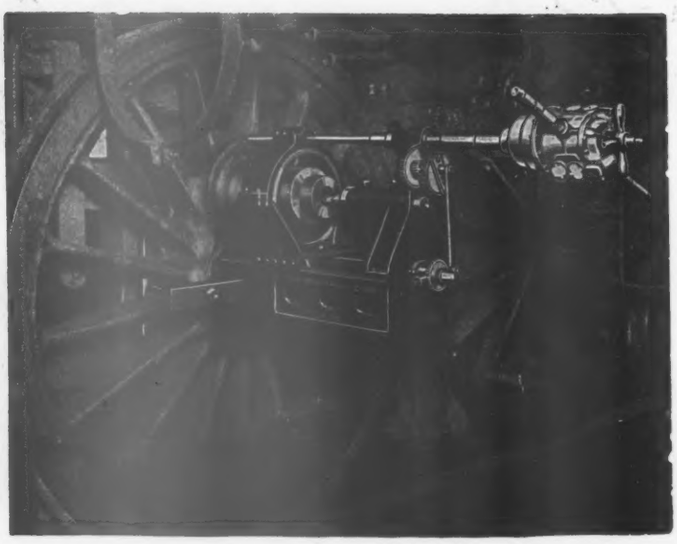
Check your figures against these. Find out what you would save by installing Niles Tools. Write for specific information or for a Niles Sales Engineer.

The Niles Tool Works Company

DIVISION NILES-BEMENT-POND COMPANY, *Hamilton, Ohio*

BIRMINGHAM	CHICAGO	DETROIT	PHILADELPHIA	SAN FRANCISCO
BOSTON	CINCINNATI	LOS ANGELES	PITTSBURGH	ST. LOUIS
	CLEVELAND	NEW YORK	ROCHESTER	

UNDERWOOD P
FOR LOCOMOTIVE R



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oper

Other Underwood Tools for Railroad Shops

Portable Valve Chamber Boring Bars

Portable Cylinder Boring Bars

Portable Air Pump Boring Bars

Portable Slide Valve Seat Turning Machines

Portable Pedestal Milling Machines

UNDERWOOD Portable Tools

H.B. UNDERWOOD CORP.

PORTABLE TOOLS
REPAIR SHOPS

ethe Wheels
ner the Engine
opn the Floor —

THE Underwood Portable Crank Pin Turning Machine quickly and economically trues up worn crank pins.

The machine is of light weight and easily clamped to the wheel hub.

Four set screws passing through the cutter head quickly center the tool preparatory to turning.

The feed mechanism is variable, automatic and reversible; and any desired feed can be obtained.

The work is at all times in full view of the operator, with the result that an accurate smooth finish is obtained.

Additional information gladly furnished at request.

PHILADELPHIA, PENNA.

electrified
WILLIAM SELLERS & COMPANY, INCORPORATED
Planing Machines, Reversing Motor Driven
These Planers are the same in general design as our regular
hines. They are provided with our well-known spiral pinion and
rack.
he driving motor is set at an
shaft,
mitting an

Manufactured by Wm. Sellers & Co., Philadelphia, Pa.

Spiral- and herringbone-gear drive from a motor shaft set at an angle makes this Sellers planer highly efficient. The G-E emergency-braking equipment insures stoppage under overload and undervoltage conditions, within ninety per cent of the normal braking time. Electric feed from an additional G-E motor on the cross-girt saves time and promotes accuracy.

Progressive machine-tool builders find G-E engineering service a powerful aid in improving their products. The modern way is to make motors and control an integral part of the machine.

More and more, manufacturers are working with G-E machine-tool specialists in putting G-E motors and G-E control on their machines. *Specify* G-E Motorized Power and you get a modern electrified machine.

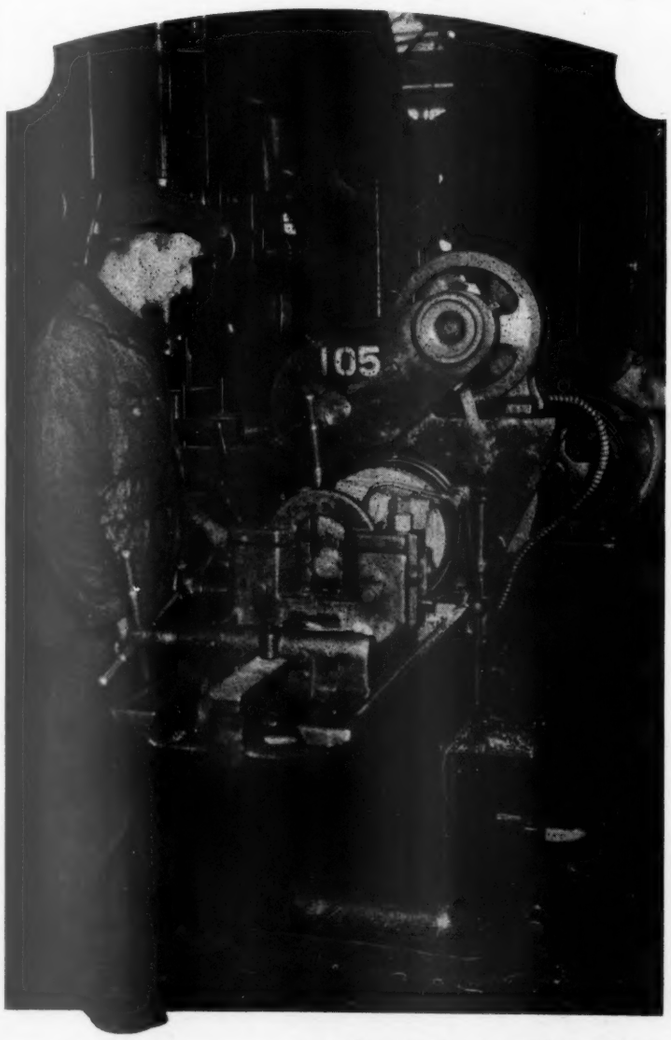
Motorized Power
—fitted to every need

GENERAL ELECTRIC

GENERAL ELECTRIC COMPANY, SCHENECTADY, N. Y., SALES OFFICES IN PRINCIPAL CITIES

For the Small Shop and Engine Terminal

THE large number of small shops and roundhouses depending entirely upon a LANDIS Single Spindle Machine for their threading requirements indicates that this unit is reliable, versatile and simple to operate.



As a general rule a 2″ machine is specified—the long bed and standard equipment of this LANDIS Machine insures a range that will take care of all the ordinary run of work.

The simplicity of the LANDIS Die Head—its ease of adjustment and long chaser life are outstanding LANDIS features which insure dependable operation, quick set-ups and fewer delays. The unit is always ready for any job.

It Costs Less to Thread the LANDIS Way

LANDIS MACHINE CO., Waynesboro, Pa.

Detroit Office—5928 Second Blvd.

DOMESTIC AGENTS: Young & Vann Supply Co., Birmingham, Ala.; Herberts Machinery & Supply Co., Los Angeles, Calif.; Herberts Moore Machinery Co., San Francisco, Calif.; Hendrie & Bolthoff Mfg. & Supply Co., Denver, Colo.; R. S. Armstrong & Brother Company, Atlanta, Ga.; Marshall & Huschart Machinery Co., Chicago, Ill.; Marshall & Huschart Machinery Co. of Indiana, Indianapolis, Ind.; Woodward Wight & Co., New Orleans, La.; Shreveport, La.; Tampa, Fla.; R. B. Whitacre & Co., St. Paul, Minn.; Colcord-Wright Machinery & Supply Co., St. Louis, Mo.; Harry M. Euler Company, Portland, Ore.; D. S. Mair Machinery Co., Houston, Texas; Salt Lake Hardware Co., Salt Lake City, Utah; Hallidie Machinery Co., Seattle, Wash.; Hallidie Company, Spokane, Wash.
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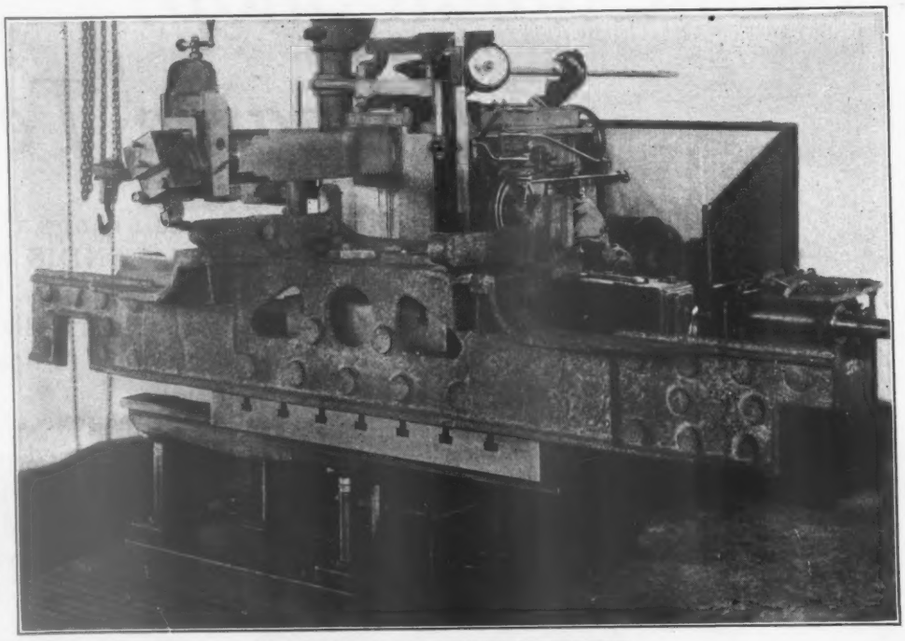
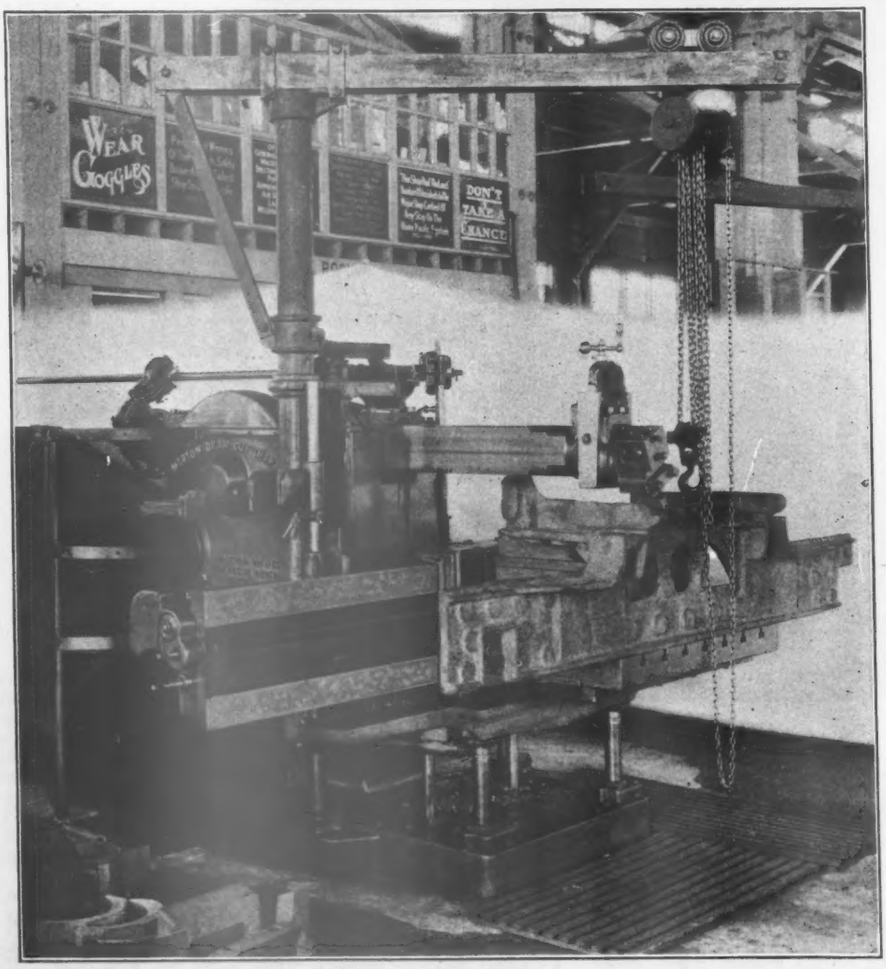
Complaints Cease When Locomotive Parts Are Finished on Morton Draw-Cut Shapers

Consider the wide range and capacity of this MORTON Draw-Cut. It has 38" of cutting stroke, 60" of horizontal or side feed, 18" of vertical feed, power rapid traverse in both directions, automatic oiling and all other features that stand for the highest degree of shaping and planing efficiency. It will slot driving boxes, finish shells that fit accurately shoes and wedges, rod brasses, cross heads and will machine the shoe and wedge fit in driving boxes with less cost than by any other method.





This MORTON Special High Duty Draw-Cut Railroad Shaper with 60" of horizontal or side feed is machining the frame fits of a guide yoke tie brace. These castings run up to 120" in length. Why place this heavy short stroke work on a large planer or milling machine when the MORTON set up is so much quicker and the work as accurate. This machine also accommodates our various attachments which are efficiency units and will slot driving boxes. It is the most profitable machine tool built for the progressive Railroad Shop of today. Let us forward full particulars and Bulletin 6R.

Include some MORTON Draw-Cuts in your next tool budget and start reducing your locomotive repair costs.

These photographs were taken in the Los Angeles, Calif., shops of a large progressive Railroad System. We will gladly furnish the name upon request.

MORTON MANUFACTURING CO., Muskegon Heights, Michigan.

Lathe Buyers- *Send for this book*

MONARCH Lathes are built in all types up to 36″ swing. Our engineers will gladly help you select the size and type best fitted for your needs.

SEND for the new Monarch bulletin. Get the facts. Compare Monarch Helical-geared Timkenized Lathes, point by point, with any other lathes you know. Then investigate the Monarch records of long life and low-cost production. Buy on the basis of *performance*.

A Challenge!

FACE the facts that count. Get a true picture of the many improvements and patented features that have resulted in new standards of lathe performance being set by Monarch Lathes.

Monarch Lathes
Helical Gears - Timken Bearings
SMOOTHER..QUIETER..MORE POWERFUL

THE MONARCH MACHINE TOOL CO.
Sidney, Ohio - U. S. A.
New York Sales Office, 857 Graybar Bldg.

The Monarch Machine Tool Co., Sidney, Ohio.

Please send us your new lathe bulletin. We are interested in the following size.....

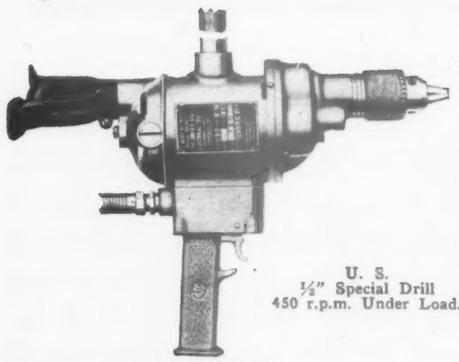
Name.....

Address.....

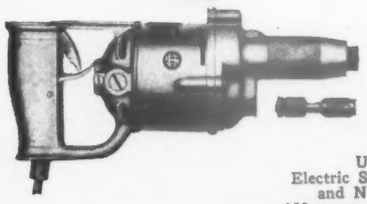
City.....*State*.....

THE STANDARD OF QUALITY
SINCE 1897

U. S.
¼" High Speed Drill
2000 r.p.m. Under Load.



U. S.
½" Special Drill
450 r.p.m. Under Load.



U. S.
Electric Screw Driver
and Nut Setter
450 r.p.m. Under Load.

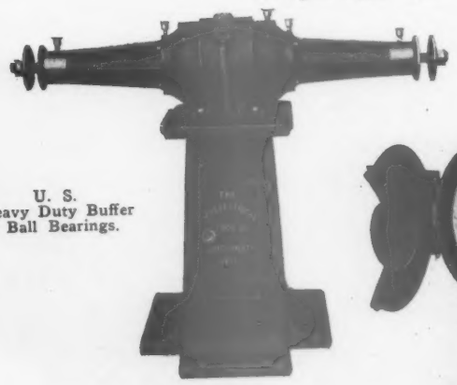
Economical

Wherever comparative tests are made for downright economy and dependability, U. S. electrically driven tools and machines stand foremost.

They have introduced practically all the new developments and refinements for lowering costs and increasing production since the first portable electric drill and electric grinder were brought out (by U. S., by the way) thirty years ago.

Get all the U. S. facts before you buy. Ask your jobber, mail us the handy coupon below, or call nearest U. S. branch.

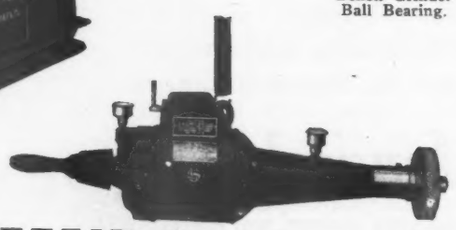
Dependable



U. S.
Heavy Duty Buffer
4 Ball Bearings.

U. S.
Heavy Duty Grinder
4 Ball Bearings.

U. S.
6", 8", 10", 12"
Bench Grinder
Ball Bearing.



U. S.
Portable Surface Grinder
Ball Bearings.

BRANCH SALES OFFICES

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The United States Electrical Tool Co.,
2487 West Sixth St.,
Cincinnati, Ohio.

Please send your latest catalog and price list to:

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Westinghouse Elec. International Co.,
150 Broadway, New York City.

British Representative:
B. E. N. Patents, Ltd.,
92 Tottenham Court.
Rd., London, Eng.

Output Averages
4 Boxes an Hour
which Includes Time To Caliper Journals

THIS is not stunt performance—operators do not have to exert themselves to turn out four boxes an hour on the Bullard Driving Box Borer and Facer—this time of course includes the caliper-ing of the journals.

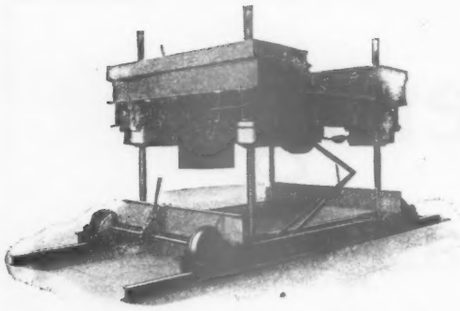
Field service reports on several recent installations show that this average is easily maintained throughout the day.

The Bullard Driving Box Borer and Facer will chuck boxes up to 23½ inches long—and the jaws which will grip 21¾ inches between faces are mounted on a two jaw universal self centering chuck provided with graduated micrometer control for cross adjustment when setting boxes off center to bore reliefs.

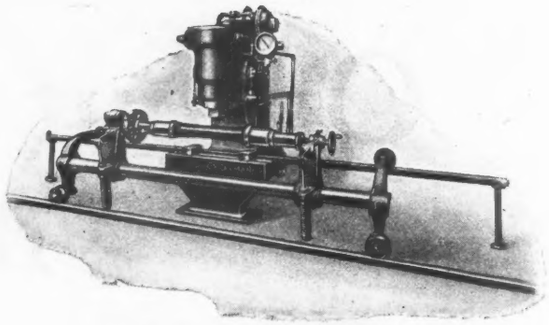
Time saving features always prominent in Bullard design are especially adapted to this machine for production and economy. This Bullard machine will insure big savings over former methods of machining driving boxes.

The Bullard Machine Tool Co.
Bridgeport Connecticut

Driving Box Borer & Facer



4 SCREW ELECTRIC DROP PIT TABLE



RILEY AXLE STRAIGHTENER

Wasco Products for use on Railroads

HYDRAULIC MACHINERY

Accumulators—Plain Weighted —Hydro-Pneumatic.
Adjusting Machines (Walter Stock) for lengthening, straightening and shortening, main and side rods, draw bars, binders, valve motion parts and other locomotive parts.
Axle Straighteners for cars and locomotives.
Benders—Beam, Pipe, Rail, Bar Shafts, etc.
Boiler Testing Pumps for all purposes.
Broaching Presses for bushings, car and locomotive parts, etc.
Bushing Presses for pressing in all kinds of bushings.
Crank Pin Presses for removing and replacing crank pins in drivers in place.
Drop Pit Equipment of all types for both locomotive and car work.
Fittings.
Forcing Presses for all classes of work.
Forging Presses—for all classes of work.
Flanging Presses for boiler, tank, etc.
Gauges—Hydraulic for all pressures.
Jacks—Horizontal and Vertical —All types from 2 to 2,000 tons.
Jacks—Hydroscrew type up to 75 tons for Locomotive and Car Work.
Jacks—Traversing.
Journal Box Presses—All types.
Laboratory Presses—Handy for compression tests.
Lifts for handling and lifting batteries, motor coaches, buses, etc.
Pit Jacks for drop pit work in Engine Houses and Terminals.
Plate Straightening Presses.
Plate Flanging Presses.
Piston Rod Puller.
Portable Presses for variety of work.
Pulling Jack for removing and replacing locomotive cylinder and valve bushing.
Pumps—Vertical and Horizontal —all sizes.
Punch Presses.
Rail Bonding Tools.
Shears—Rod, Bar and Plate.
Shock Absorbers for Hydraulic systems.
Straighteners—Beam, Pipe, Rail, Shaft, Axle, Steel Castings, etc.
Spring Banding, Forming, Stripping and Testing Presses.
Tire Forcing Presses for Auto Coaches and Trucks.
Riveters—Pneumatic, Hydraulic and Hydro-Pneumatic Types —all sizes and capacities.
Valves—Operating of any type, size or capacity.
Wheel Presses—Hand, Belt or Motor Driven — Plain, semi-pneumatic and full hydro-pneumatic.

POWER TOOLS

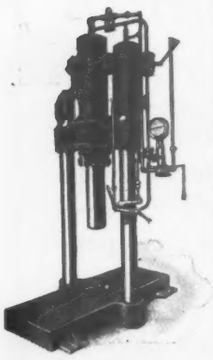
Benders—Rail. **Drop Pit Tables**—Electric—for all purposes

WRITE FOR BULLETINS

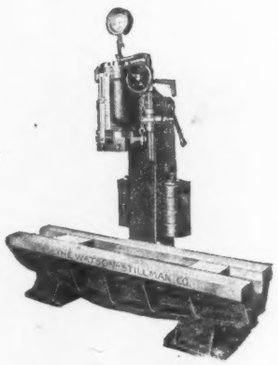
The Watson-Stillman Co.

116 Washington Street **New York City**

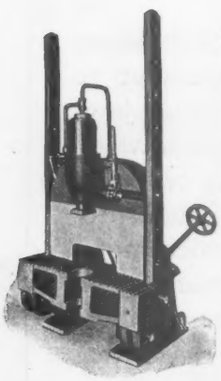
Chicago Pittsburgh Philadelphia
Cleveland St. Louis Detroit
Richmond, Va.



JOURNAL BOX FORCING PRESS

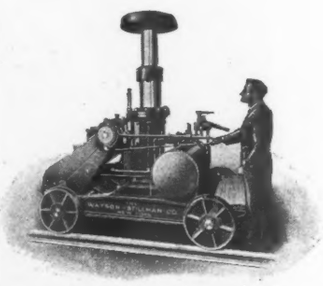


HYDRAULIC SPRING TESTING PRESS



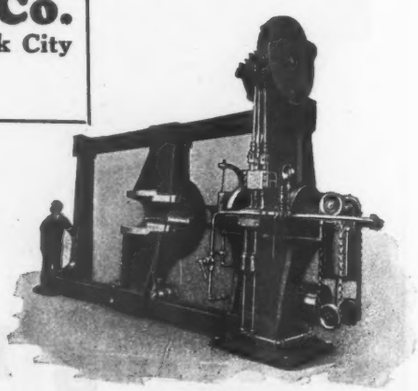
VERTICAL-HORIZONTAL HYDRAULIC PRESS

Can be used in either vertical or horizontal position



SELF-PROPELLED HYDRO-PNEUMATIC PIT JACK FOR USE WITH DROP TABLE

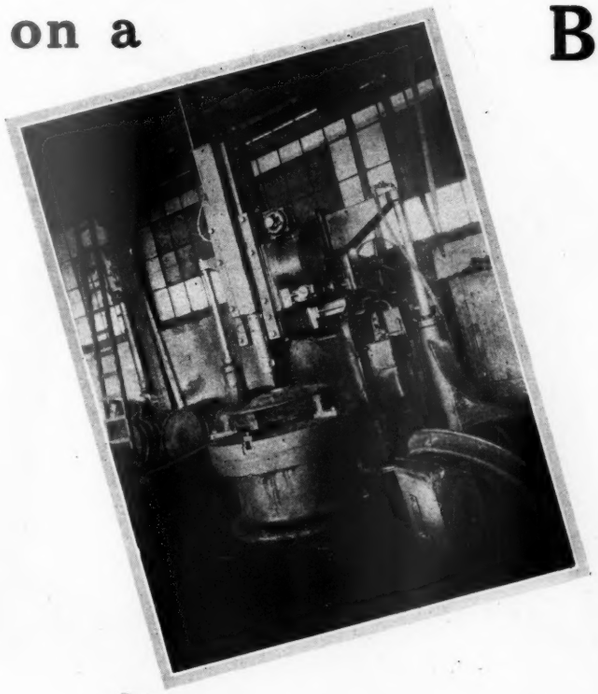
WALTER STOCK ADJUSTING MACHINE

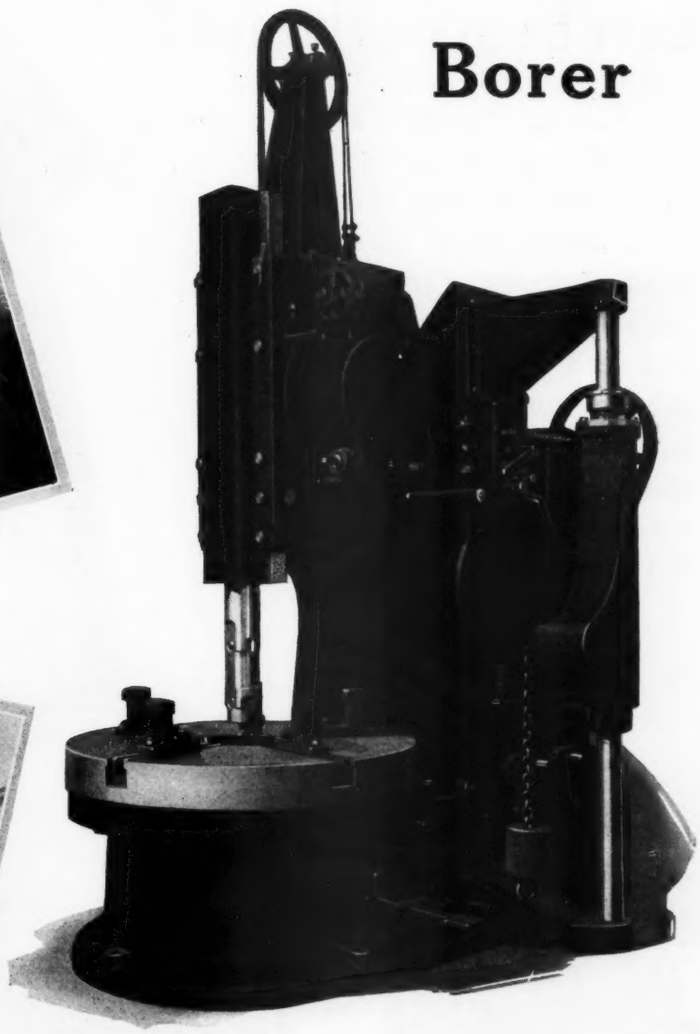


600 TON HYDRO-PNEUMATIC WHEEL PRESS

Dependable Production

on a Betts Car Wheel Borer





The best evidence we can offer for Betts Car Wheel Borers is the fact that we are receiving repeat orders from some of the best known car shops where you will find these machines doing the bulk of the work.

Bulletin 6100 gives complete specifications. We'll be glad to mail you a copy.

BETTS . . NEWTON . . COLBURN . . HILLES & JONES . . MODERN

CONSOLIDATED

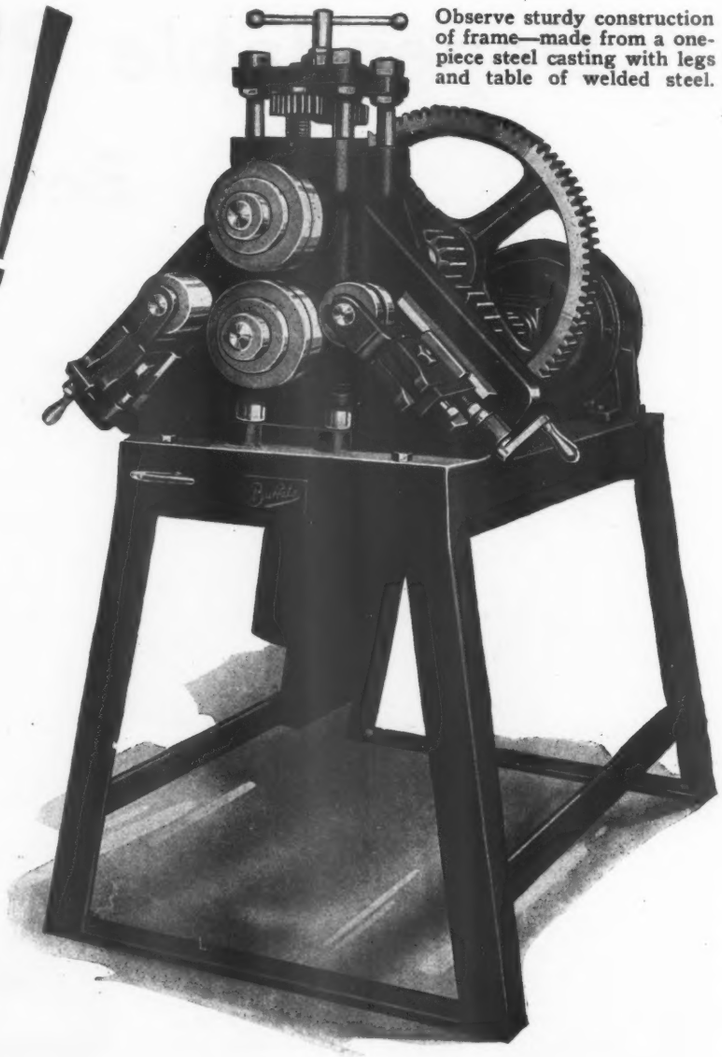
CONSOLIDATED MACHINE TOOL CORPORATION *of* AMERICA, Rochester, N. Y.

18

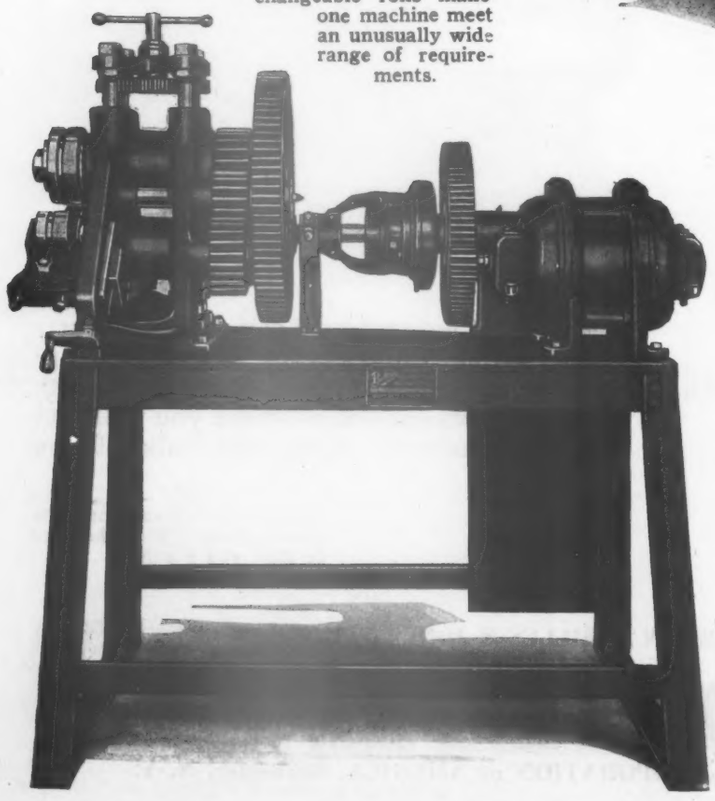
AT LAST!

The machine you have been waiting for!

Although the new Buffalo No. "O" Bending Roll has only been on the market a very short time, it has already become a pronounced favorite in railroad shops where it is successfully employed for bending flats—squares — angles — tees — channels — beams — copper tubes and steel pipes, WITHOUT heating.



Observe sturdy construction of frame—made from a one-piece steel casting with legs and table of welded steel.



Adjustable and interchangeable rolls make one machine meet an unusually wide range of requirements.

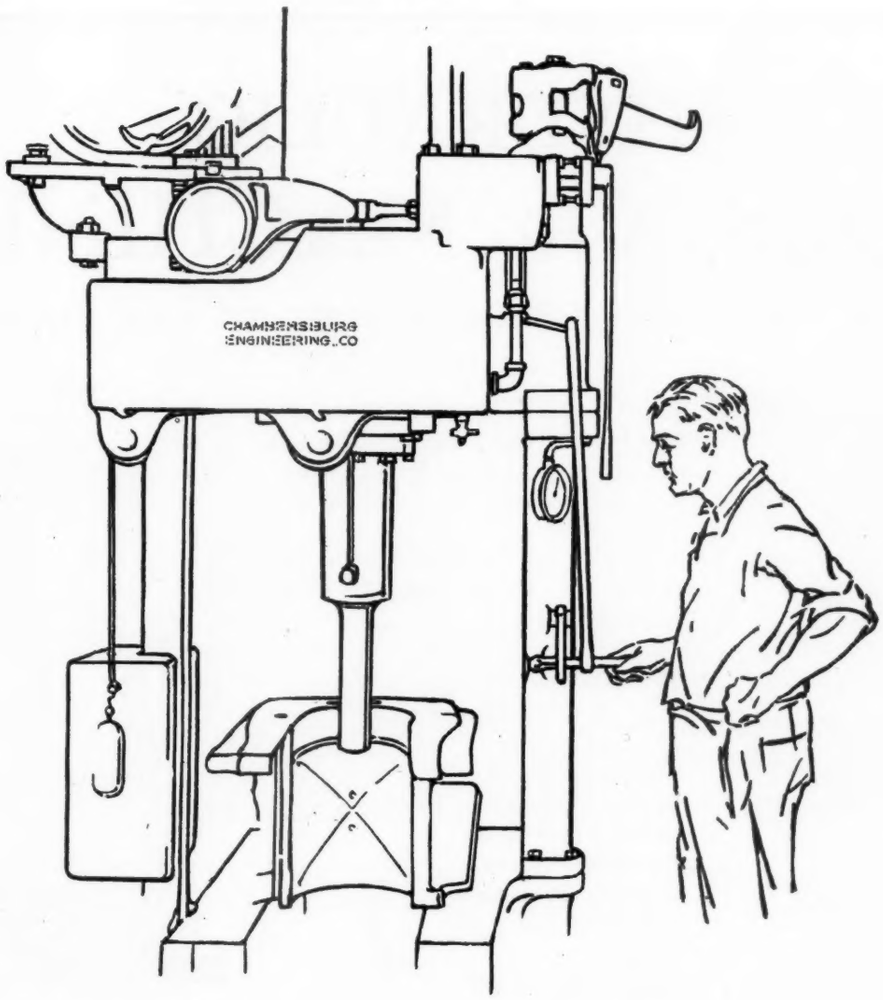
If you are interested in lower bending costs write today for a copy of Bulletin No. 326 which gives complete specifications and shows samples of work done by the Buffalo No. "O" Bender.

Buffalo Forge Co.

441 Broadway, Buffalo, N. Y.

In Canada—

Canadian Blower & Forge Co., Ltd., Kitchener, Ont.



ONE convenient feature of the Chambersburg Hydraulic Bushing Press is the mounting of the motor, pump and crane on the top platen, with the water reservoir in the platen itself. This allows free access to the press from all sides.

The control valves and gauge are on the side of the machine convenient to the operator.

Railroad Shops, Automotive and General Machine Shops will find this bushing press an exceptionally fast worker, applicable to a wide variety of uses. Like all Chambersburg equipment simplicity, ruggedness, accessibility of parts, and great working convenience have been given thorough attention.

CHAMBERSBURG-NATIONAL
COMPLETE FORGING EQUIPMENT

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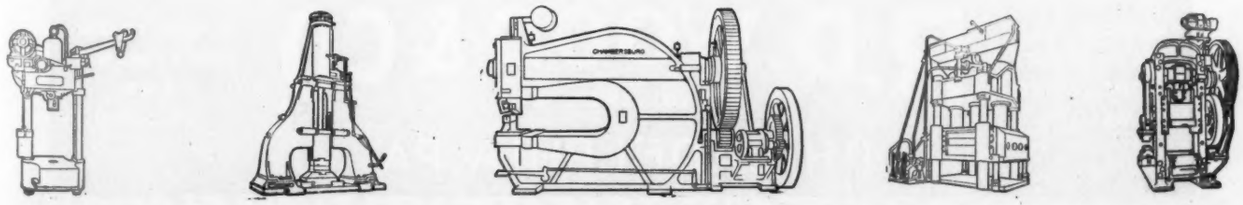
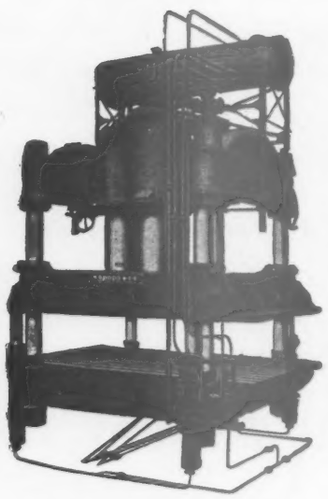


CHAMBERSBURG ENGINEERING CO. . . . . THE NATIONAL MACHINERY CO.

HYDRAULIC TOOLS AND MACHINERY

FOR RAILROAD, LOCOMOTIVE AND CAR SHOPS

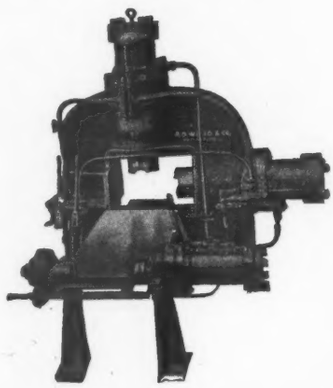


1500-TON FOUR COLUMN FLANGING PRESS

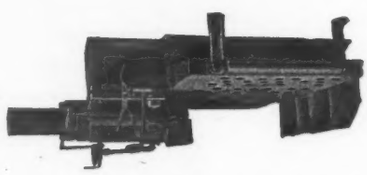
We build a complete line of up-to-date hydraulic tools designed for efficiency and economy in operation.

Our standard hydraulic tools are manufactured in all sizes and types, and comprise:

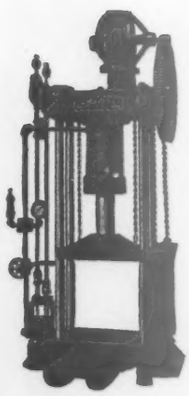
Four Column Flanging Presses
Sectional Flanging Presses
Riveters
Bushing Presses
Wheel Presses
Crank Pin Presses
Bending Presses
Forging Presses
Punches
Shears
Spring Machinery
Accumulators
Pumps



HYDRAULIC SPRING BANDING PRESS



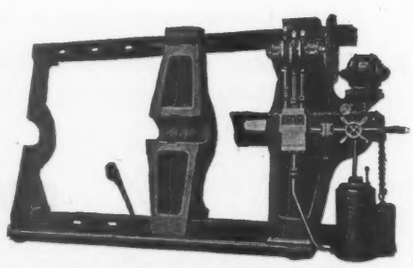
HYYDRAULIC BULLDOZER



HYDRAULIC BUSHING PRESS

Our experience, extending over a long period of years, together with our excellent shop facilities also enable us to design and build hydraulic machinery to meet any special requirements.

Our illustrated catalogues "Hydraulic Machinery" and "Hydraulic Valves & Fittings" mailed upon request.



HYDRAULIC DRIVING WHEEL PRESS

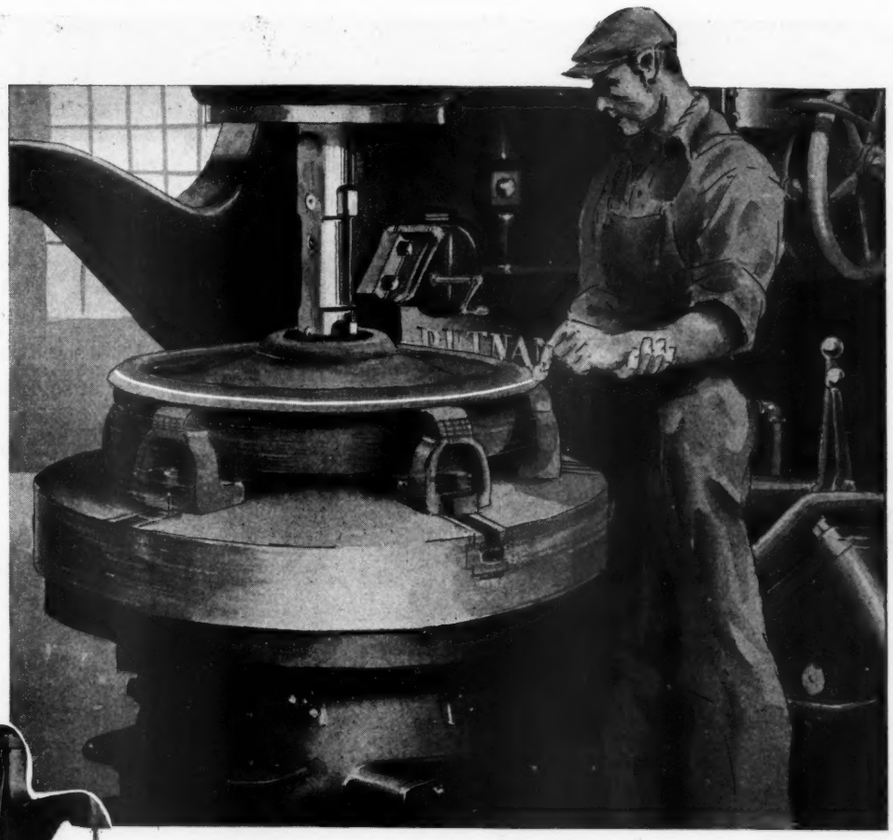
HYDRAULIC MACHINERY & OPERATING VALVES

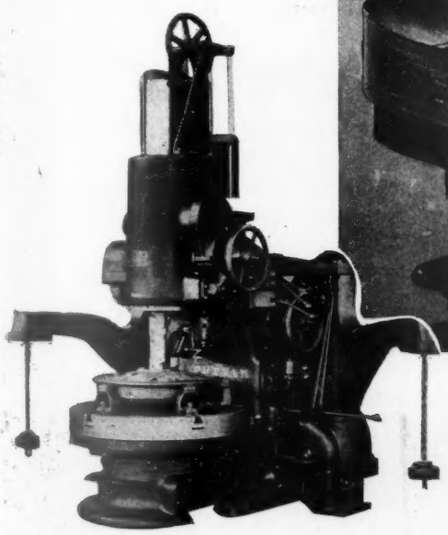
R. D. WOOD & CO.

ESTABLISHED 1803

PHILADELPHIA, PA.

CAST IRON PIPE, HYDRANTS AND VALVES





Centered at once...

...and centered to stay

THE Putnam pneumatic chuck on the Putnam Car Wheel Borer grips the wheel at once . . . . and centers it for keeps.

A turn of the valve does the trick. The wheel *can't* raise or get out of alignment because the chuck grips the wheel smoothly, powerfully, never-failingly . . . . like the action of a giant hand. No lost time re-centering and re-aligning the work. Your operator spends *all* his time producing . . . . and so does the machine.

To release the work just reverse the valve.

No shock in starting to strain belts, twist shafts and damage gears . . . . no elaborate controls to cause trouble and expense.

Bulletin 4B describes and illustrates this Putnam pneumatic and also our very simple mechanical automatic chucks as adapted to the Putnam Car Wheel Borer. Write for your copy.

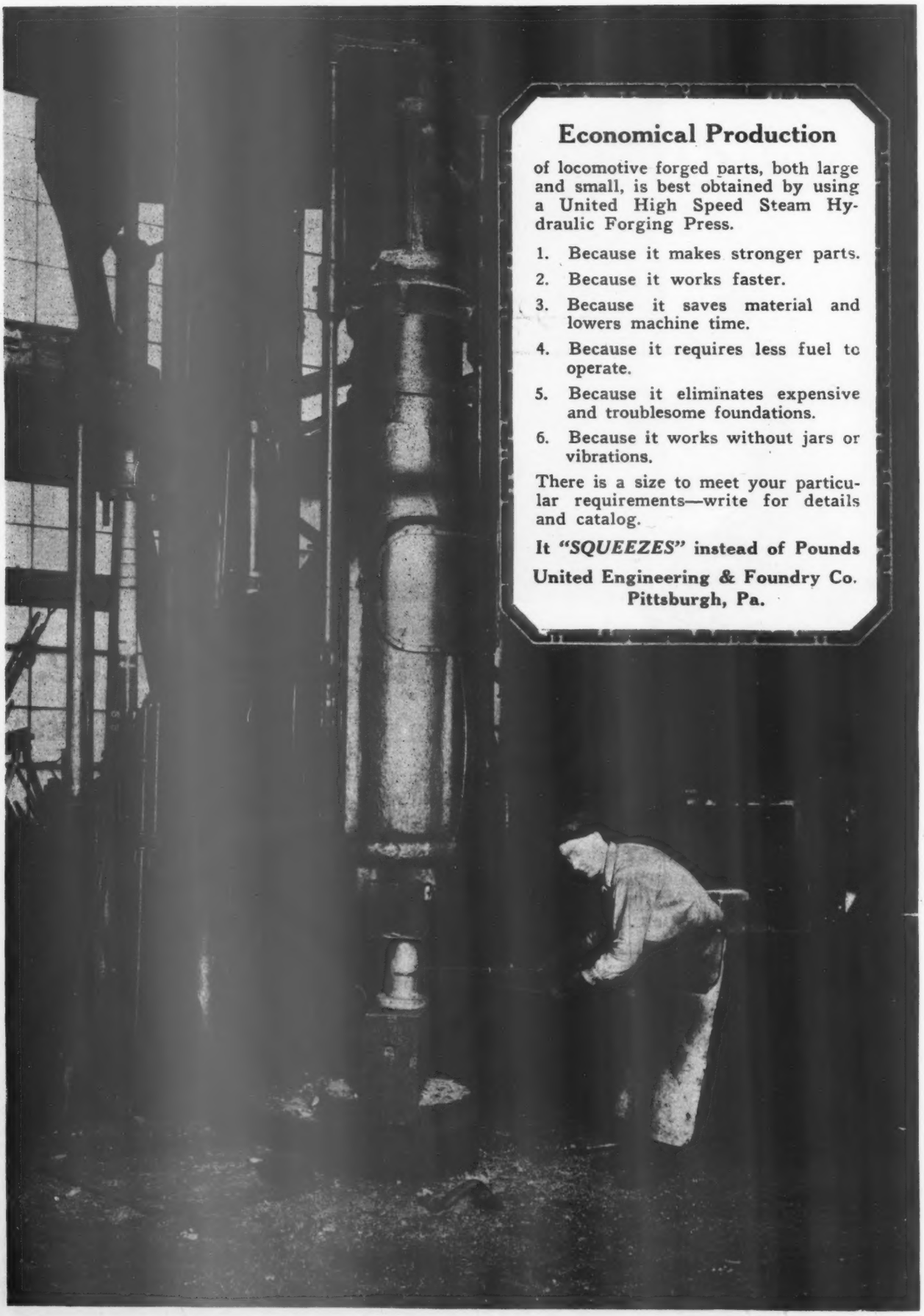
RAILROAD SHOP TOOLS

- Car Axle Burnishing Machine.
- Car Axle Borers.
- Frog and Switch Planers.
- Coach Wheel Lathes.
- Driving Wheel Lathes.
- Journal Turning, Quartering and Pin Turning Machine (Large).
- Quartering and Pin Turning Machine (Small for auxiliary work).
- Car, Journal and Axle Lathe.

SHAW CRANE-PUTNAM MACHINE CO., INC.
PUTNAM WORKS: FITCHBURG, MASS.
Also Manufacturers of Shaw Electric Cranes—Works: Muskegon, Michigan
General Offices: 100 East 42nd Street, New York, N. Y.

Subsidiary of

MANNING, MAXWELL & MOORE, Inc.


Economical Production
of locomotive forged parts, both large and small, is best obtained by using a United High Speed Steam Hydraulic Forging Press.
1. Because it makes stronger parts.
2. Because it works faster.
3. Because it saves material and lowers machine time.
4. Because it requires less fuel to operate.
5. Because it eliminates expensive and troublesome foundations.
6. Because it works without jars or vibrations.
There is a size to meet your particular requirements—write for details and catalog.
It "SQUEEZES" instead of Pounds
United Engineering & Foundry Co.
Pittsburgh, Pa.

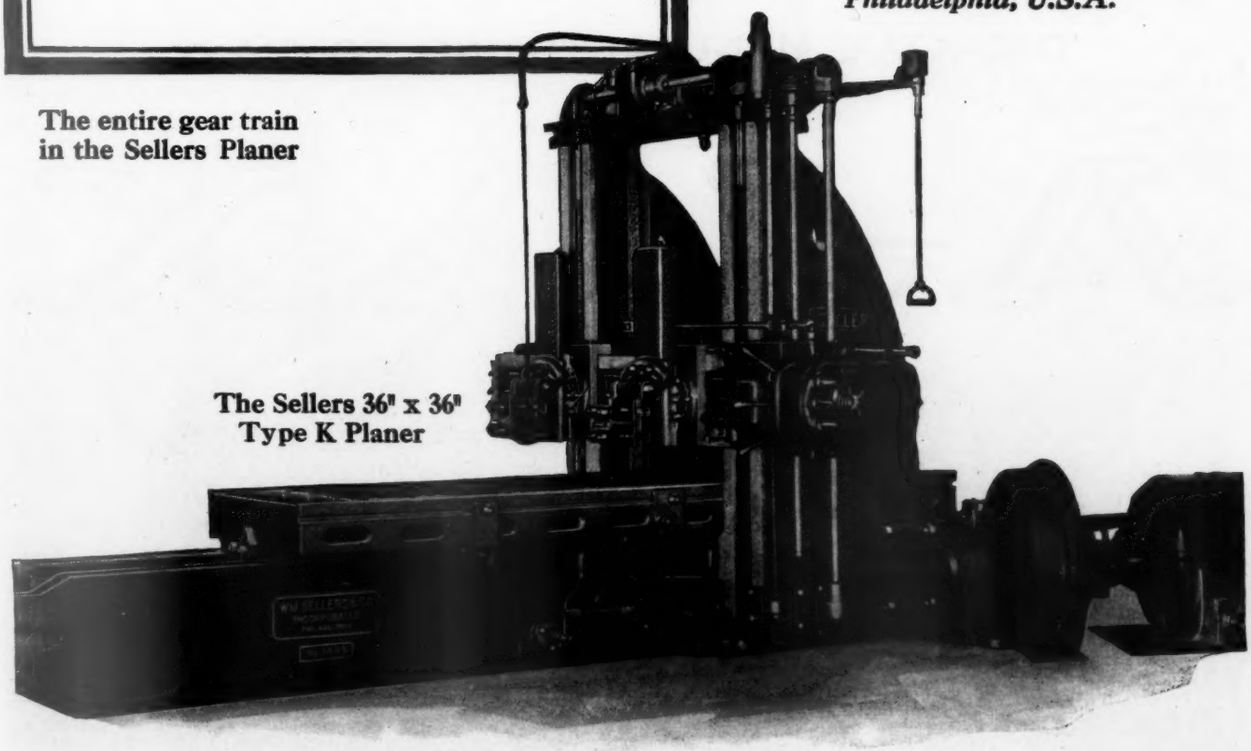
Only 3 Gears from motor to table rack

The entire gear train in the Sellers Planer

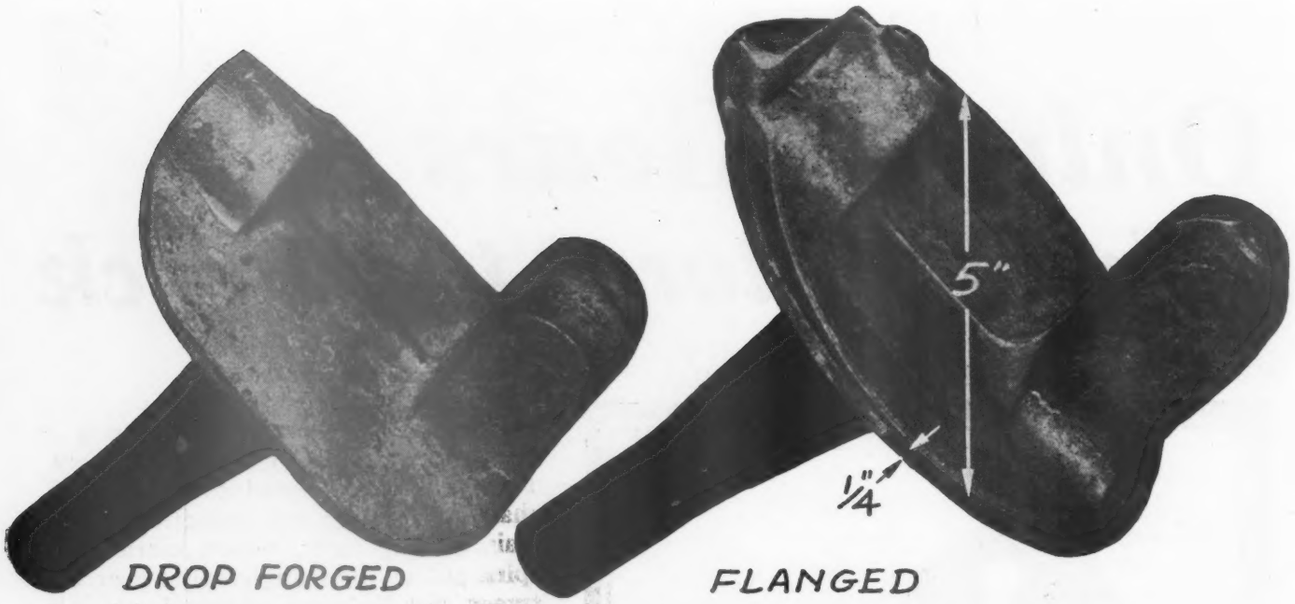
The simplest gear train possible is a feature common to Sellers Planers. The motor is coupled to the pinion shaft and through one reduction to the main driving shaft, which carries the spiral pinion. The single spiral gear between the bedways allows for ample rigidity without making it necessary to carry the central portion of the bed casting below the floor line.

The newest Sellers Planer—Type K—combines the distinguishing features of previous machines with other improvements that materially simplify the mechanism and add to the convenience of operation. It is illustrated and described in detail in Catalog 714. Let us mail you a copy.

WM. SELLERS & CO.
INCORPORATED
Philadelphia, U.S.A.



The Sellers 36" x 36" Type K Planer



What's Your Toughest Upsetting Job?

ONE that takes the life right out of a forging machine and makes it grunt on the final stroke.

Ten to one it's a thin flanging job with no cushion, where the dies and heading tool come "metal to metal";—the kind that breaks piston rods on steam hammers and crankshafts on forging machines.

Flanging jobs test a forging machine and Ajax Machines stand the test. Flanges 5" in diameter ¼" thick; 11" in diameter 1" thick and big fellows 15" in diameter 1½" thick are turned out by Ajax Machines by the hundred thousands, day in and day out without breakdowns.

The tie rod re-enforced bed with rigid crankshaft housings; the sturdy twin gear driven crankshaft; and the drop lock that converts a maximum of flywheel energy into actual work are merely three of the exclusive Ajax Construction features you should acquaint yourself with before buying a forging machine.

Our Bulletin 63 will be sent upon request. Or better still, let one of our sales engineers call.

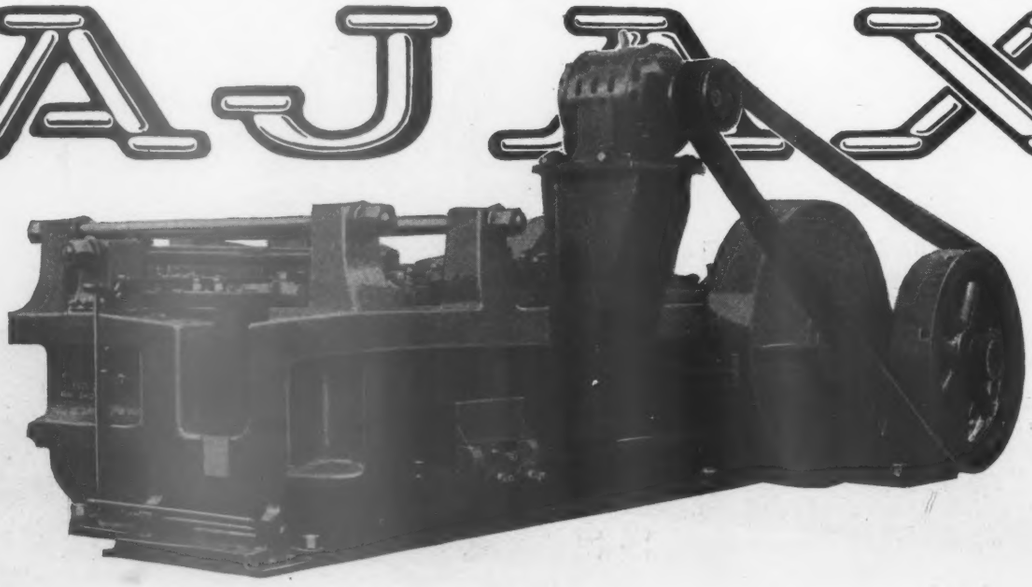
THE AJAX MANUFACTURING COMPANY

621 Marquette Bldg.
140 So. Dearborn St.,
Chicago, Ill.

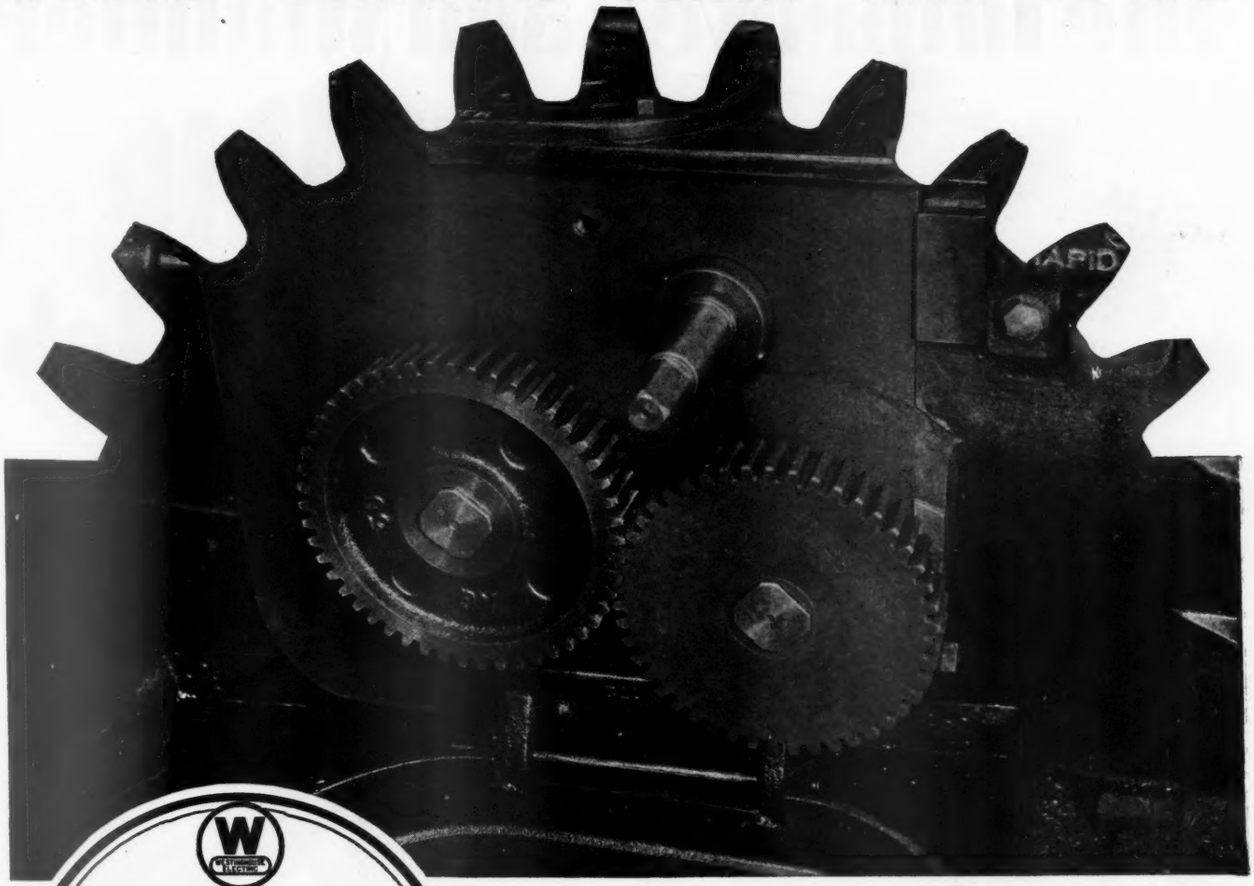
Euclid Branch P. O.
Cleveland, Ohio

1369 Hudson Terminal
50 Church St.
New York City

AJAX



WHERE MICARTA GEARS ARE GOING



Gear Cut by Newark Gear Cutting Machine Company, Newark, N.J.

On Gear Hobbers

AFTER two years of service on a Newark Gear Hobber at the Newark Gear Cutting Machine Company, the Micarta gear, shown in the illustration, is still in excellent condition. This is another example of Micarta gear stamina.

Micarta gears perform quietly, eliminating the noisy clatter of metal gears; and their resiliency and strength enable them to withstand shocks that would break ordinary gears.

Micarta gear manufacturer-distributors can give you prompt gear cutting service.

MICARTA

Silent
Gears & Pinions

Manufacturer-Distributors

ALA. Birmingham
Moore-Handley Hardware Co.
Chas. T. Steward Machine Co.
CALIF. Los Angeles
Los Angeles Automotive Works
San Francisco
Pacific Gear & Tool Works
COLO. Denver
Colorado Gear Mfg. Corp.
Stearns Roger Mfg. Co.
ILL. Chicago
Foote Bros. Gear & Machine Co.
Gears & Forgings, Inc.
D. O. James Mfg. Co.
A. Piamondon Mfg. Co.
MD. Baltimore
Murrill & Keizer Co.
MASS. Boston
Grant Gear Works
Springfield
Perkins Machine & Gear Co.
Woburn
Massachusetts Gear & Tool Co.
Worcester
Beacon Gear Shop
MO. Kansas City
United Iron Works
N.C. Gastonia
Ferguson Gear Co.
N. J. Elizabethport
The A. & F. Brown Co.
Newark
Newark Gear Cutting Machine Co.
General Machine Co.
Paterson
Watson Machine Co.
Watson Flagg Engineering Company
N. Y. Brooklyn
Braun Gear Corp.
Buffalo
A. F. Oliver Gear & Machine Co., Inc.
New York
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Syracuse
Deifendorf Gear Corp.
OHIO Cleveland
Cloyes Gear Works
Gears & Forgings, Inc.
Hamilton
Niles Tool Works Co.
PA. Philadelphia
Rodney Davis
Charles Bond Co.
Pittsburgh
Gears & Forgings, Inc.
R. D. Nuttall Co.
Simonds Mfg. Co.
TEXAS Houston
Houston Armature Works
WASH. Seattle
Western Gear Works

Westinghouse Electric & Manufacturing Company
East Pittsburgh Pennsylvania
Sales Offices in All Principal Cities of the United States and Foreign Countries

Westinghouse

T 30202

The Improved and Mightier TRIMO Is On The Job

Last month the news went out to the wrench users of America of a new and phenomenal pipe wrench—the Improved and Mightier TRIMO.

Today the Improved and Mightier TRIMO is on the job—living up to every claim we made for it—proving itself the strongest and safest wrench of its kind on the market.

Today it is a known fact that we were not boasting when we said "Stack the Improved and Mightier TRIMO Up Against the World for Strength."

Scientifically heat treated handle — powerful reinforcing side lugs — unbreakable steel frame of improved design — these new strength features make TRIMO the unquestioned leader of quality pipe wrenches.

TRIMONT MFG. CO., INC.

ROXBURY (BOSTON) MASS.

Viewed from any Angle

The Landis Gap Grinder is the Tool you need for Heavy Grinding

PRECEDING advertisements have given you a "circular" view of the new Landis Gap Grinder.
They have called particular attention to:

1. **Its weight and rigidity.**
2. **Its self-contained drive.**
3. **Its hydraulic carriage traversal with a speed range of 12″ to 240″ per minute.**
4. **Its 30″ diameter grinding wheel.**
5. **Its end drive to the grinding wheel spindle.**
6. **Its convenient and easy operation.**

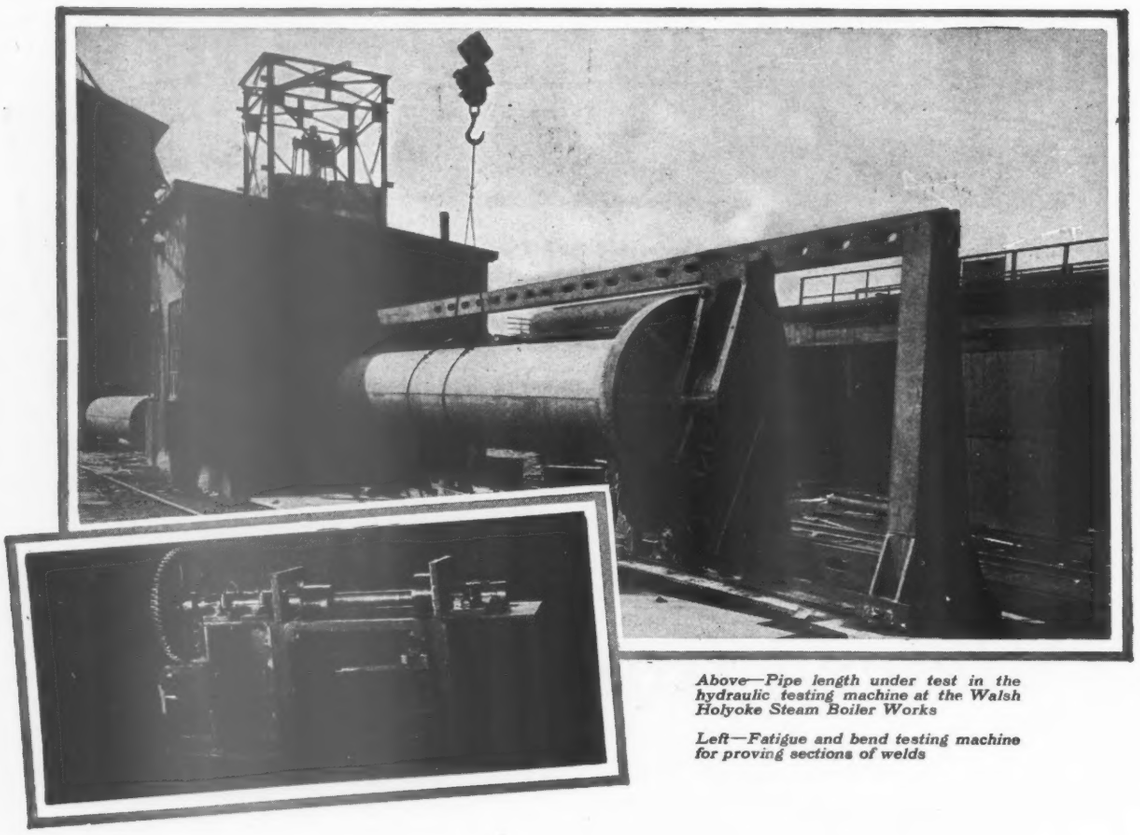
Other preceding advertisements have explained in detail the design and function of individual parts of the machine—so that viewed from any angle it meets your needs for quick and accurate grinding of wrist pins, valve yokes, piston rods and axles.

If you have missed any of these preceding advertisements or desire further information, send for catalog I-28. It gives the facts!

LANDIS TOOL COMPANY

Waynesboro, Pa.

New York Chicago Detroit



Above—Pipe length under test in the hydraulic testing machine at the Walsh Holyoke Steam Boiler Works

Left—Fatigue and bend testing machine for proving sections of welds

The Test of the Weld

THOROUGH TESTS were conducted on each four-ton pipe length for the new Springfield, Mass., water system before it was hauled from the Walsh Holyoke Steam Boiler Works. Every section was welded with G-E electrodes and then subjected to severe fatigue and bending tests. Every pipe length went into the hydraulic testing machine. Every seam was proved a sound, tough weld.

G-E ELECTRODES enable fast operation, form beads of uniform strength, and produce welds which can be proved by tests exceeding in severity the actual conditions of service. The more you arc weld, the more you save—when G-E welding electrodes are used.

G-E WELDING ELECTRODES (Type "F" for general steel welding, Type "B" for automatic welding, and Type "A" for welding cast iron) can be obtained from special distributors of G-E welding electrodes, conveniently located throughout the country to give you prompt service. Get in touch with the G-E Welding Electrode Distributor near you or write to the Merchandise Department, General Electric Company, Bridgeport, Connecticut.

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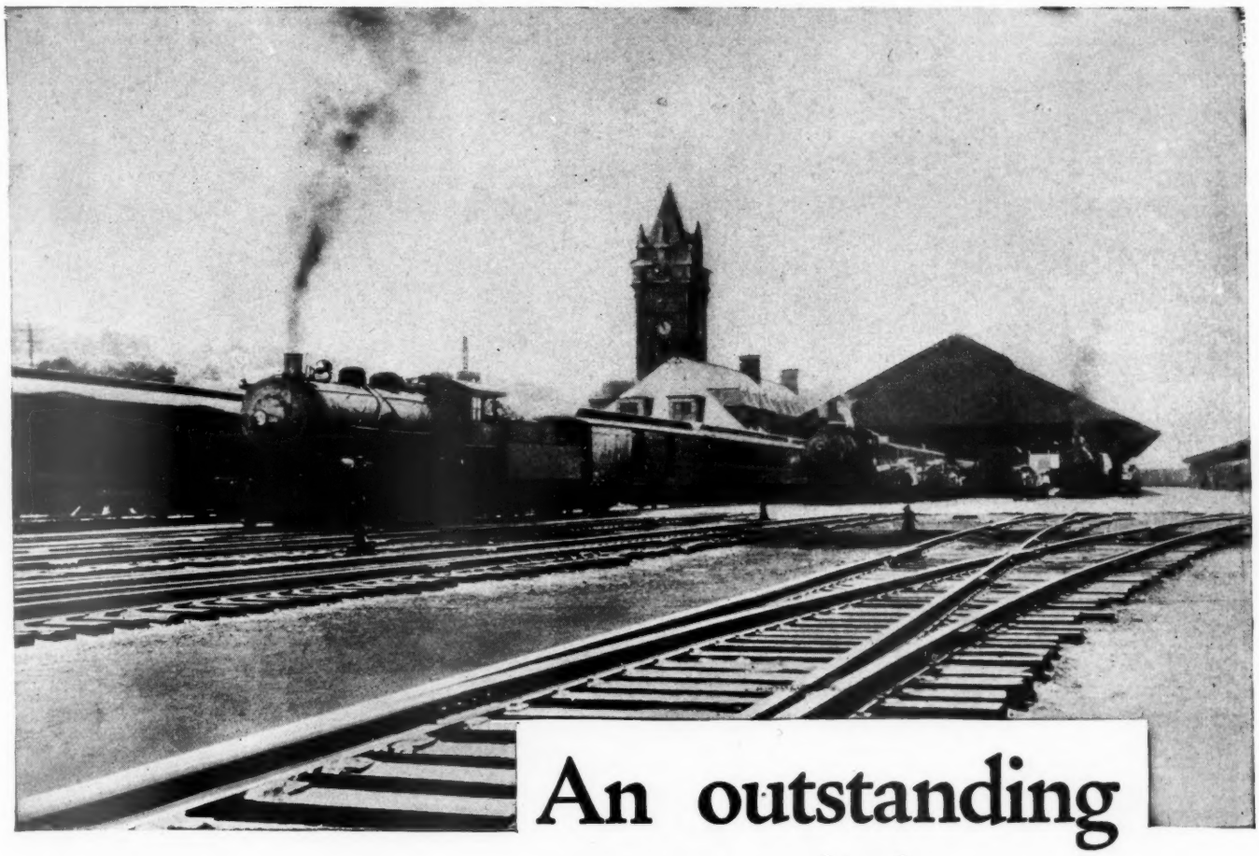
GENERAL ELECTRIC

MERCHANDISE DEPARTMENT, BRIDGEPORT, CONNECTICUT



An outstanding accomplishment

IN March 1928, after five years of boring through the Rockies, the first train passed through the Moffat Tunnel in northwestern Colorado. It is the highest tunnel in the world and the longest in America, penetrating six miles of solid rock at an elevation of 9,000 feet.

The Moffat Tunnel furnishes the gateway to a veritable empire which is larger than all France. In this great undeveloped area are coal lands more extensive than those of Pennsylvania and West Virginia combined, enough oil to supply the whole country for a thousand years, and ten billion feet of timber.

This is a spectacular triumph of railroading. But the remarkable efficiency of every-day railroad service provides an even greater insurance for the growing prosperity of America.

The Oxweld Railroad Service Company is helping to maintain the high standards of modern railroading by supplying the oxwelding needs of most of the important railroads of the country. It is a railroad type of organization, equipped by years of experience to cooperate with any railroad.

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Unit of Union Carbide UCC *and Carbon Corporation*

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A No. 1 frame fits are essential to satisfactory locomotive performance. They cannot be obtained with irregular, dull, chattering reamers.

Brubaker Engineers have studied this job and know the conditions to be overcome. The result is that Brubaker taper frame reamers have the exact steel analysis, the proper clearances and the correct heat treatments to insure a good job.

Catalog No. 6 gives sizes and prices

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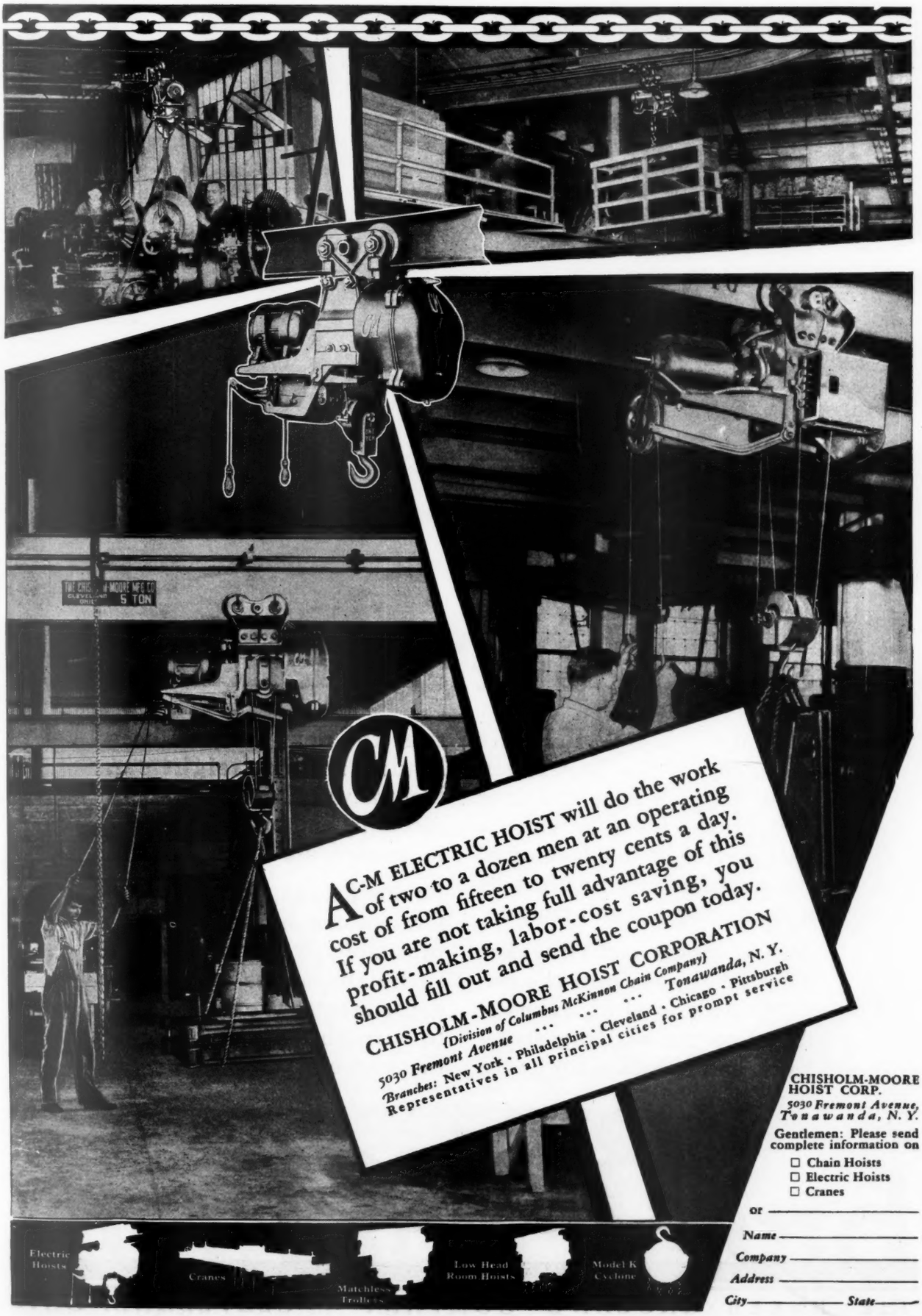

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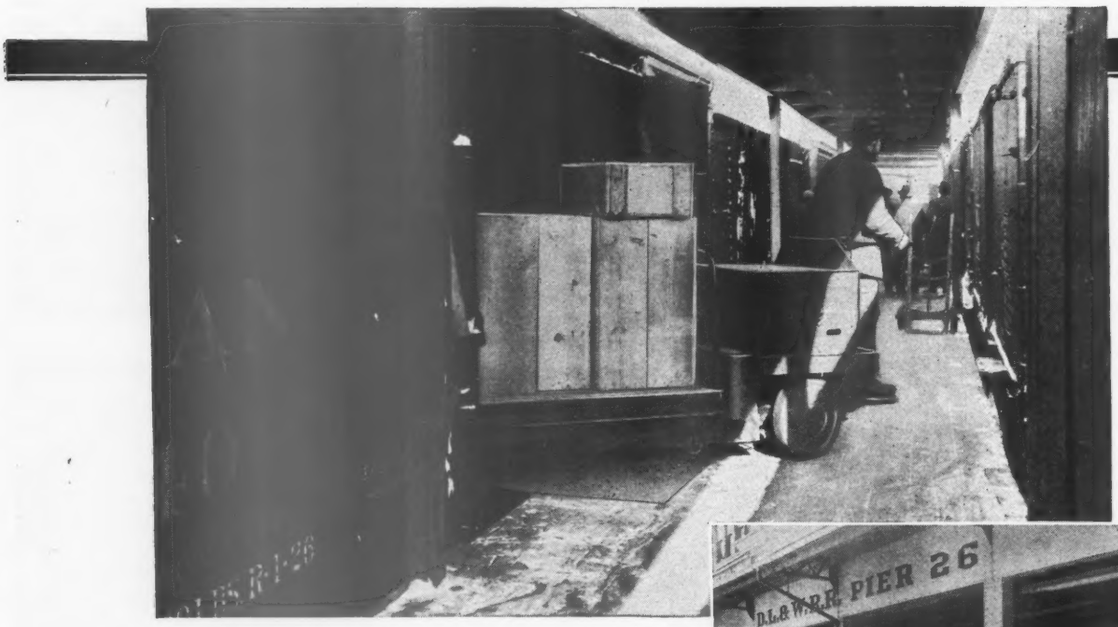

How the D. L. & W. speeds up freight handling

AT the D. L. & W. R. R. Pier 26, on the East River, New York, a fleet of Baker Lift Trucks loads or unloads package freight in a fraction of the time formerly required by a small army of hand truckers.

Men in the car load a live skid. The Baker goes into the car, picks up the skid, takes it direct to the waiting street truck, and is back again by the time the next skid has been loaded in the freight car. Naturally the handling of both incoming and outgoing freight is speeded up.

Baker Trucks, Tractors and Cranes can be used just as profitably by other railroads in freight, stores and shops departments. We will be glad to furnish facts and figures that prove it.

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TRADE-MARK REG. U.S. PAT. OFF.

Baker

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I-R Air Motor Hoists

for low cost lifting and handling

Ingersoll-Rand air motor hoists have established a reputation for reliable and economical service on hundreds of different hoisting jobs. Their rugged, compact construction avoids troubles and delays.

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There are seven sizes, capacities 500 to 20,000 lbs.

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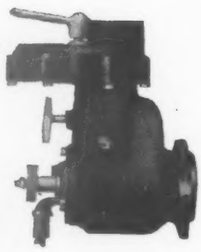

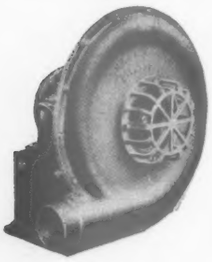

The problem that confronts all operators of oil fired industrial heating equipment.

Mahr Equipment will successfully burn heavy fuel oil in the coldest winter weather.

There are three steps in the burning of cold heavy fuel oil:—

1st—Heat the oil to a sufficient high temperature to make it fluid.
Use the Mahr steam or electric oil heater.

2nd—Provide the correct pressure and volume of air.
Use the Mahr Individual direct connected low pressure blower.

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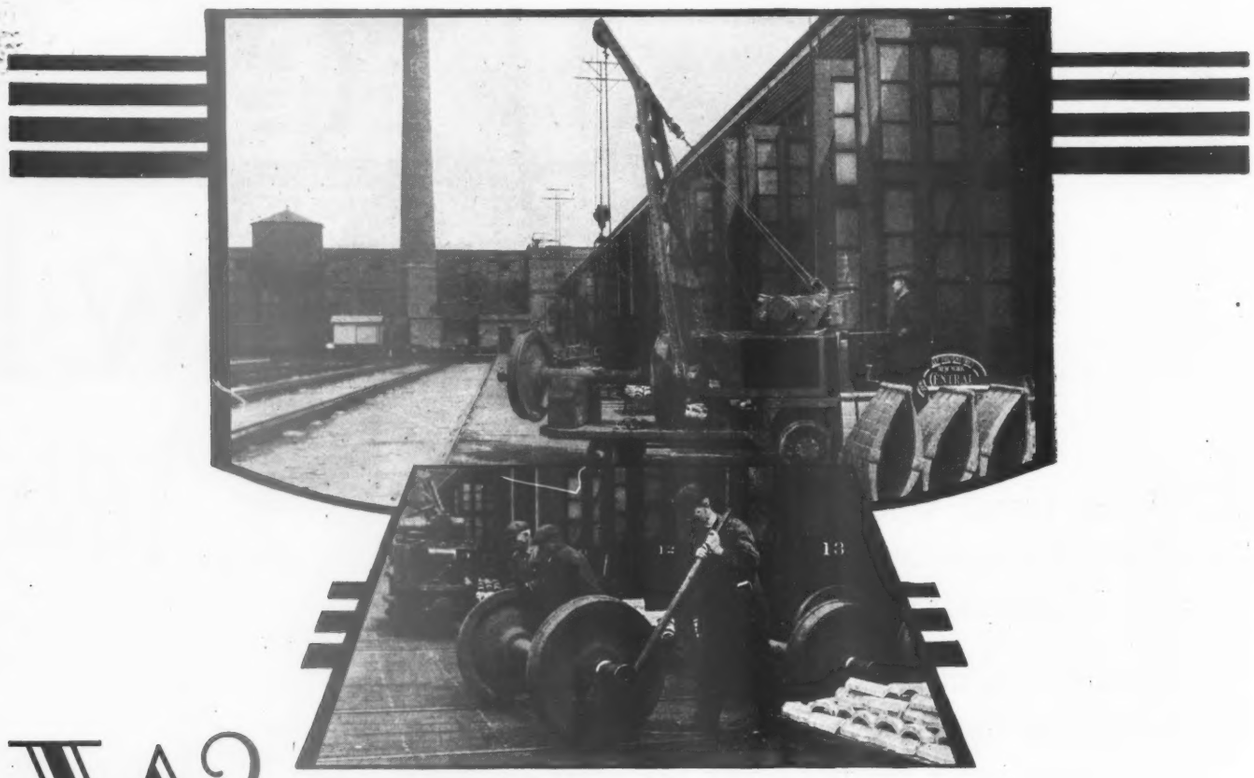

Which Do You Prefer?

Moving car axles by hand labor takes *three* men —to say nothing of the possibility of damage to the axle or the chance that the whole business may escape and roll down an incline or ramp.

Moving car axles with an E-P crane tructor takes *one* man and makes "safety first" an actual fact.

Moving car axles is but a simple illustration of the limitless ways in which Elwell-Parker Tructors and Tractors are being used in moving parts and materials in repair shops, round houses, stores and freight terminals. Moreover, the Tructor you put on the job today will not only more than pay its way this year and next, but ten, even fifteen years from now. Elwell-Parker Tructors are made to stand the hardest kind of rough usage. Built from drop forgings of alloy and open-hearth steels, they last for years—many have seen 10 years and more of service on scores of railroads. Our nearest representative will gladly prove how Elwell-Parkers cut costs — save workmen — speed transportation.

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With Self-tapping Screws you, too, can cut costs of sheet metal repairs

Just two simple operations
Drill a hole . . Turn in the Screw

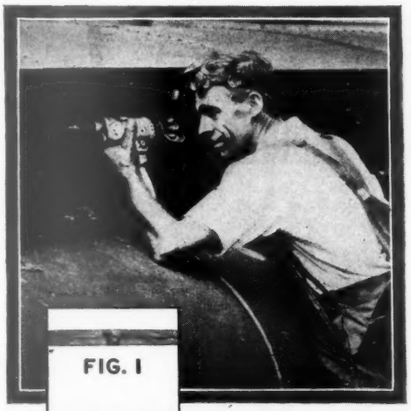

FIG. 1

FIG. 2

First—drill or punch a hole as in Fig. 1; or pierce a hole as in Fig. 2.

Then—turn in the Screw with a screw driver. As the Screw is turned in, it cuts its own thread like a tap, drawing the parts firmly together.

The fact that so many prominent railroads are using these unique Screws for joining and making fastenings to sheet metal ought to interest you because if they find their use advantageous, there is no question but that you will, too.

Parker-Kalon Hardened Self-Tapping Sheet Metal Screws are capable of cutting their own thread in sheet metal up to 10 gauge in thickness. They eliminate the slow and costly tapping operation necessary when machine screws are used and make more substantial fastenings.

That is why they are so widely used in railway shops for patching leaky metal car roofs, for attaching fixtures, hardware, etc. to metal car interiors, for repairing window flashings on passenger cars, for boiler lagging on locomotives and for sheet metal work generally around shops, train sheds, etc.

We can only tell you about the savings that are effected through the use of our Screws but you can prove our statements in your own shops, on your own work by trying the samples we will gladly send you without cost or obligation. Write for samples today.

and for making permanent fastenings to iron, brass and aluminum castings, steel, etc. More than 18,000 manufacturers use these unique Screws. They are hammered in Write for free samples and full information.

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Easy to Control—No Recoil—Just Floats.
Power Pocket—Multiplies Force of Blow.
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Jenkins — in the pipe line

THE engineer knows that Jenkins in a pipe line is a valve that he can forget about—a trustworthy valve that has many years of usefulness.

Jenkins Valves win and hold the respect of the man close to their operation, as well as the purchasing agent who figures ultimate valve cost on the basis of long-term economy. There is a reason for this: Jenkins are made for the maximum service, not merely the average.

High manufacturing standards are rigidly maintained. Precautions are taken in every department, and the finished valve must pass a wide-margin test before it leaves the Jenkins factory.

Jenkins Valves are furnished in bronze and iron—in standard, medium and extra heavy patterns . . . . at supply houses everywhere.

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JENKINS BROS., Limited, Montreal, Canada; London, England
Factories: Bridgeport, Conn.; Elizabeth, N. J.; Montreal, Canada

Below, Valve Division, Bridgeport, Conn.

Fig. 108 Jenkins Standard Bronze Angle Valve, screwed

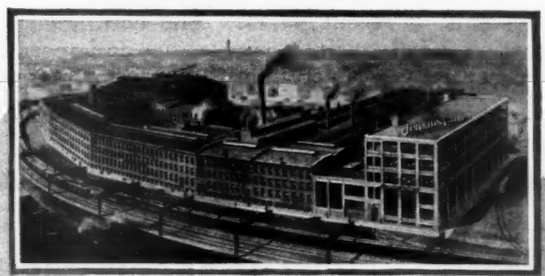

Fig. 325 Jenkins Standard Iron Body Gate Valve, screwed

Always marked with the "Diamond"

Jenkins Valves

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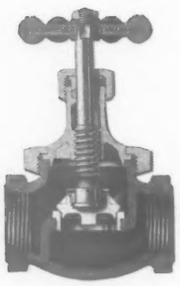
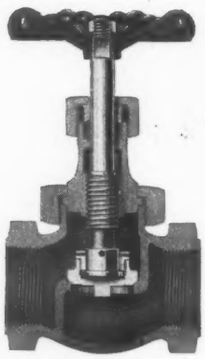
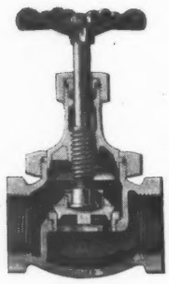
Effective Aids in the Attainment of Maximum Operating Efficiency



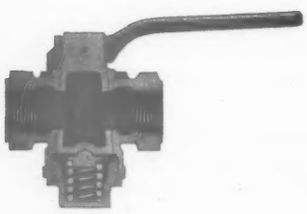
Iron Body
"Ferrenewo" Valve
150 lb. W. S. P.
Renewable Nickel Alloy Seat and Disc



Bronze
"R. R. Regrinding" Valve
250 lb. W. S. P.
Renewable Bronze Disc

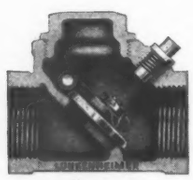


Bronze
"Renewo" Valve
200-300 lb. W. S. P.
Renewable Nickel Alloy Seat and Disc



Bronze
"Air-Liquid" Cock
150 lb. Pressure

Bronze
Wedge Disc Gate Valve
200-300 lb. W. S. P.



Bronze
Regrinding Swing Check Valve
200-300 lb. W. S. P.

LUNKENHEIMER VALVES

have kept pace with the remarkable progress made by the great railway transportation systems in recent years. The continued urge for greater economy in operation is influencing maintenance and operating executives to specify and purchase valves strictly on the basis of actual service results.

The reasons are obvious why so many of these discriminating buyers insist upon having "Lunkenheimer."

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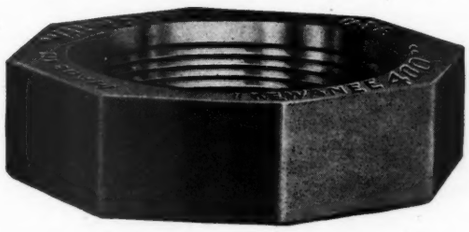
THE KEWANEE "400"

Forged Steel Bottom



Forged Bronze Thread End

With the New Forged Steel Ring

NO INSERTED PARTS

A new union that has "class", as its name suggests . . . the "Kewanee 400" is an all-forged union designed to keep step with the upward march of steam pressures and temperatures.

The famous three-piece principle of the Kewanee Union, and the forged bronze to forged steel non-corroding joint are retained.

The old malleable iron ring has been replaced by a forged steel ring so that the thread connection, also, is now forged bronze to forged steel which gives the "Kewanee 400" increased strength and resistance to high pressures.

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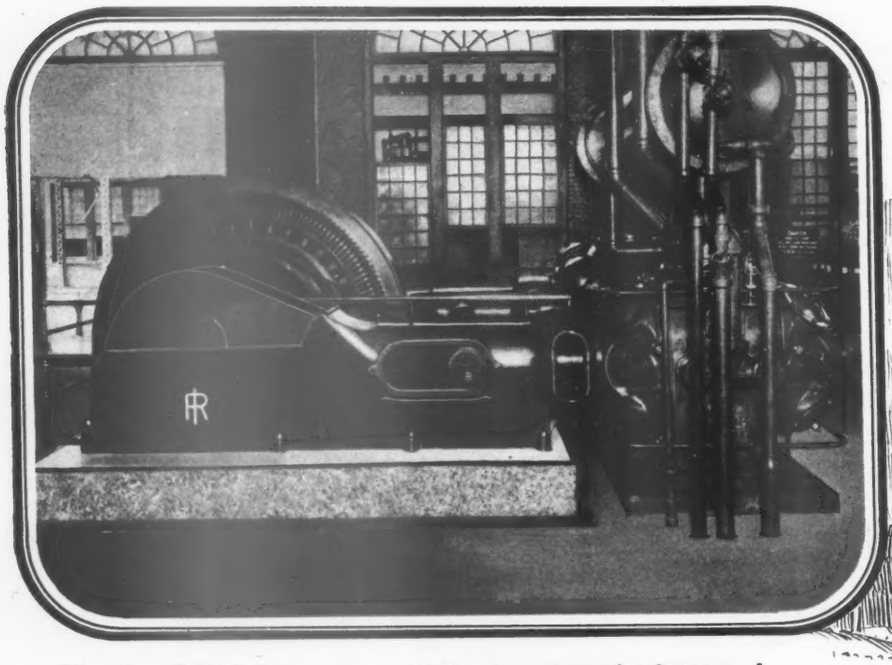

The Class PRE-2 Compressor embodies the noteworthy features of 5-step clearance control regulation and synchronous-motor-drive

Where the Best Means Economy

Railroad transportation is indispensable to American life and business. Passengers and freight must be moved promptly and speedily.

This can be accomplished only with locomotives and rolling stock that are in good condition. The shops are therefore of vital importance and anything that improves shop practice helps move traffic.

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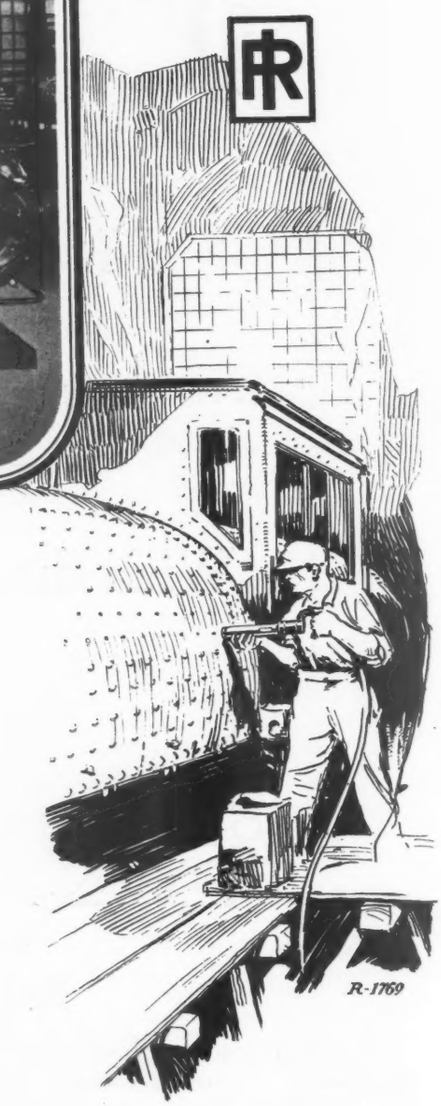
Ingersoll-Rand compressors and tools for railroad shops are of the most modern design, and incorporate the best materials and workmanship.

Their merited reputation for dependable service had led to their use by most of the important railroads of the country.



Ingersoll-Rand furnishes a complete line of modern pneumatic tools for railroad shops

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For Canada refer—Canadian Ingersoll-Rand Company, Ltd., 10 Phillips Square, Montreal, Quebec.

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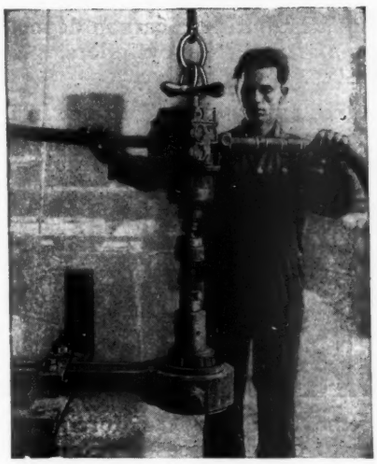
Ingersoll-Rand

The Faessler-Maupin Method

for applying side and main rod and motion work bushings and brasses



The Faessler-Maupin Method is applicable to brass, bronze, cast-iron, machinery steel, babbitt, or any other metal that is not hardened, and may be used for split as well as solid bushings, or bushings with oil grooves.

What it does

Expands and rolls the bushings to an accuracy of 0.0001-in.

Compresses and hardens the bearing surface of the metal.

Tightens the bushing in place.

Finishes the hole true both circumferentially and longitudinally.

Provides a smoothness of surface that cannot be duplicated by any other method.

Forces lubricant into the pores of the metal improving the initial operation of the bushing.

The result

Reduces the cost of applying bushings.

Prevents loose bushings and brasses.

Eliminates breaking-in.

Greatly improves service of bushings and mileage obtained.

Reduces bushing renewals.

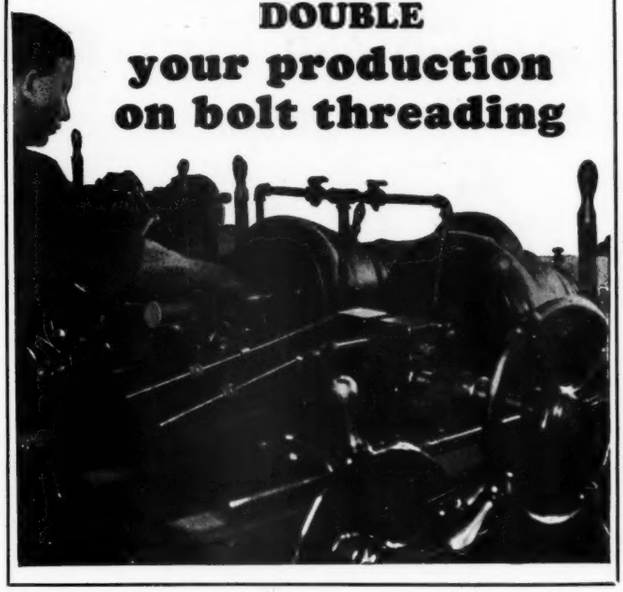
Write for full information

J. Faessler Mfg. Co.

Main Office and Works

MOBERLY, MO.

Sure, you can DOUBLE your production on bolt threading



Big increases obtained with Williams Twin-head Bolt Threaders!

You can work two different set-ups at the same time with the WILLIAMS "Rapiduction" 2-in-1 bolt threader—

For instance on the two-inch machine, your operator threads a ½-inch bolt on one head, and a 2-inch bolt on the other at the same time, at the proper speed for each size. And the machine's *three-times-faster* threading pace means a much bigger production of bolts threaded.

Besides, your operator has the extra advantage of 8 *spindle speeds on each head*—he can instantly get the best speed for each size of bolt. Giving the machine's maximum speed on every set-up— less time used in actual threading —more bolts threaded.

Another important time-saving feature of the twin head "Rapiduction" is the handy dual control from either side of the machine. Convenient levers give your operator instant control from any working position.

You'll find many more improvements that you'll like—that mean *bigger bolt threading production.* Write for Bulletin "R."

Williams Tool Corporation

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Canadian Plant: Brantford, Ontario.

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AIR FILTERS

positively remove 99-9/10% of foreign matter from the air. It not only reduces wear on moving parts as much as 75 to 85%, but also reduces carbon deposits 60 to 70%. Consequently, machines are kept new and more efficient so they will do more work and can be operated from 3 to 5 times longer before overhauling is necessary—doing away with frequent shutdowns for repairs.

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PIPE LINE FILTER

Pipe lines equipped with the Model CP Protectomotor Filter will deliver clean, dry air for paint spraying, compressed-air tools, hoists, cleaning operations, agitating liquids, ice-making, chemical processes, etc.

It removes all water, oil, dust, rust, scale and other foreign matter from air passing through pipes and prevents wear and damage caused thereby.

Protectometer

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Let us send you a Protectomotor on 30 days free trial. If it does not do all we claim, return it and the trial won't cost you a cent. Write for booklet and full information.

Staynew Filter Corp.

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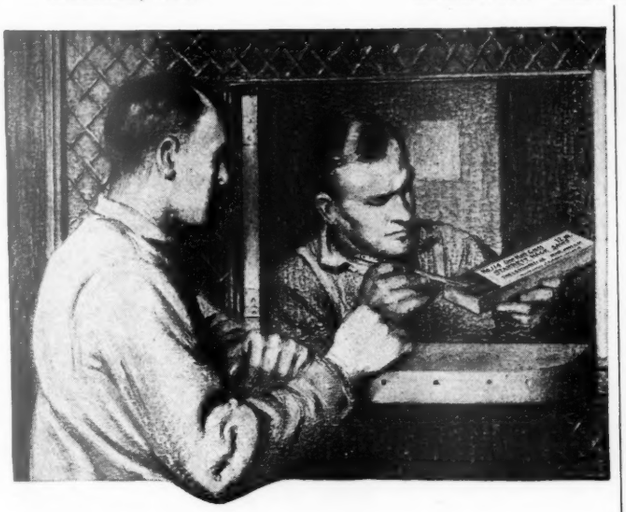

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World's Greatest Toolmakers

Manufacturers of Hacksaws Unexcelled Steel Tapes—Standard for Accuracy
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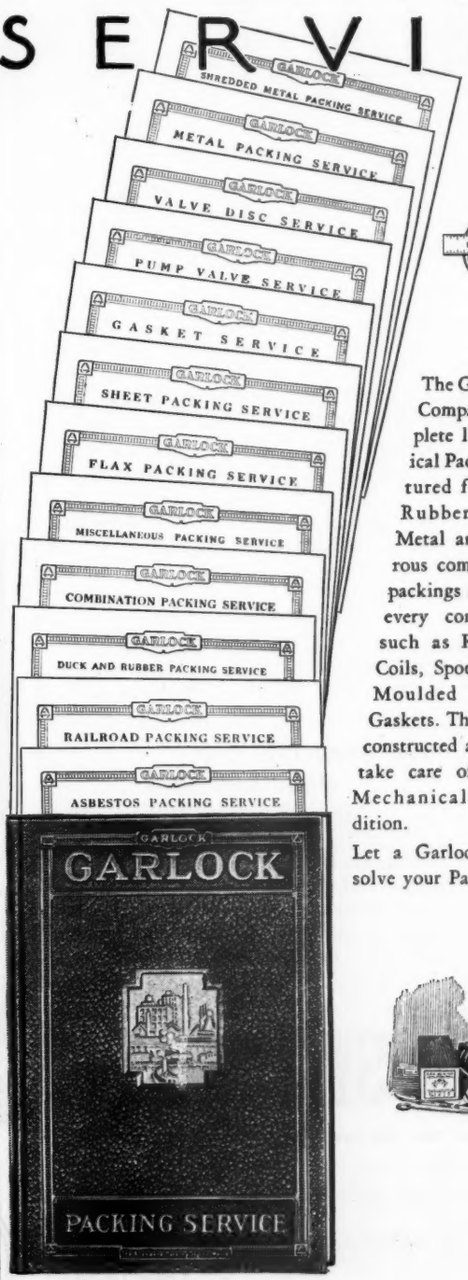
GARLOCK *Sells Complete Mechanical* PACKING SERVICE



The Garlock Packing Company sells a complete line of Mechanical Packings manufactured from Asbestos, Rubber, Duck, Flax, Metal and various Fibrous compounds. These packings are produced in every conceivable form, such as Rings, Spirals, Coils, Spools, Reels, Sets, Moulded Specialties and Gaskets. They are designed, constructed and processed to take care of any existing Mechanical Packing condition.

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THE GARLOCK PACKING COMPANY
PALMYRA, NEW YORK
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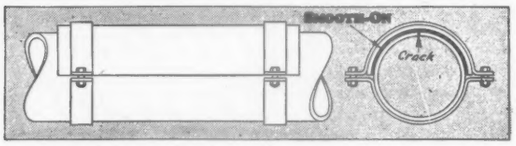
To stop leakage at a crack in a high-pressure pipe



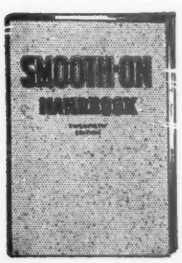
Here's a repair you can apply to any pipe, for a crack of any length, to make the line perfectly tight with any fluid, against any pressure.

By splitting a section of pipe of larger diameter and slightly longer than the crack, make a shell which will just fit over the pipe. Tamp a putty of Smooth-On No. 1 into the crack, put enough more onto the outside to fill the space between line and shell, and draw the shell down tight with strap-iron clamps. The line will give way elsewhere before pressure can destroy this bond.

The repair as shown in the sketch, is for a common straight split in a wrought pipe. If the split extends around, as is possible on cast-iron or spiral-riveted pipe both halves of the split shell can be applied. The latter arrangement is also excellent to reinforce weak locations in an old pipe line where corrosion and pitting have thinned and weakened the walls, or where erosion from gritty liquid inside has worn holes through.

Other simple but effective methods of applying Smooth-On No. 1 are illustrated and explained in the Smooth-On Handbook, which will be sent free on return of the coupon.

Get Smooth-On No. 1 in 1 or 5-lb. can or 25, 50 or 100-lb. keg from your nearest dealer or if necessary, direct from us.



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Twentieth Edition—136 pages of data—193 diagrams, pictures and practical hints on at least 200 different uses for SMOOTH-ON. Every progressive engineer should have this book—get your copy NOW.

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12-28

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Watch results on your machines—these chucks set new accuracy standards, have a tremendous grip and are speedy in operation.

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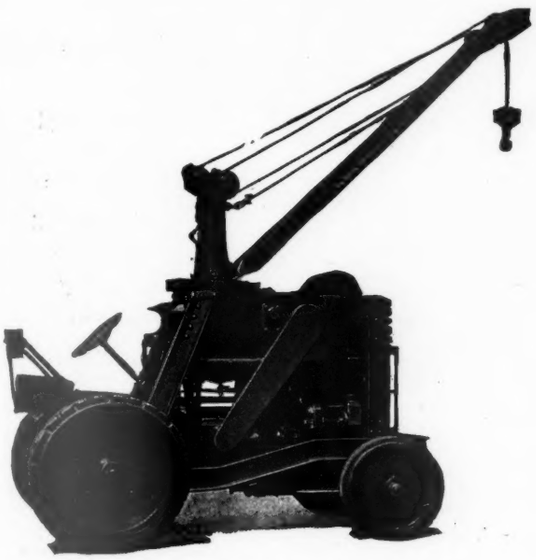
The World's Largest Producers of "Drill Chucks."

25th Anniversary
Jacobs Chucks

THE

LOADMASTER

SWING-CRANE



LOADMASTER Locomotive Type Swing-Crane

The "Loadmaster" is especially designed for handling loads which are too small to justify the installation of large crane units or which by reason of their location are not within reach of ordinary hoist service.

Gasoline-powered, tractor-mounted, it moves from place to place under its own power, and will lift, carry, swing, load and pull as the job requires.

An extremely efficient unit for handling stores department materials, and at freight terminals, transfer points, scrap and reclamation yards, repair shops, etc.

Will handle loads up to 3,000 lbs.

Write for latest Circular with full details.

FREDERIC H. POOR, INC.

50 Church Street, New York

$1040

Earns $1000

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Sullivan Hoists

Smash Car Pulling Costs

A Utah Smelter was keeping two locomotives and crews busy handling slag cars. One outfit collected the cars from the furnaces, and the other hauled trains to the dump.

Then somebody suggested Sullivan Hoists for the collecting job. Two 480-lb. electric units were installed. Each was placed to handle cars from two of the four furnaces in operation.

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One engine and crew was taken off, with a resulting saving of $1000.00 monthly.

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Send today for the picture book, "Handy Hoisting and Hauling."

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Two 80 Ton 4 Motor Type E Northern Cranes with 10 Ton Auxiliary Hoists

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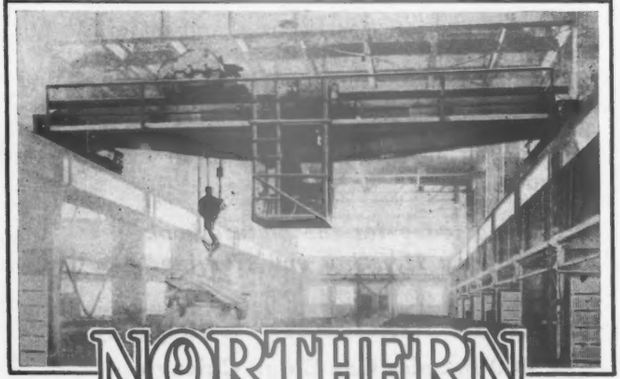
RAILROAD
CRANES

Dependable, powerful, smooth running, easily handled—these requirements are found in Northern Railroad Cranes. They are built to a high standard of construction, their design is peculiarly adapted to railroad use and abuse. They are typical railroad cranes in every respect.

Let us tell you all about them. Send for our latest bulletin No. 201-C.

(Below) 25 Ton Northern Railroad Crane



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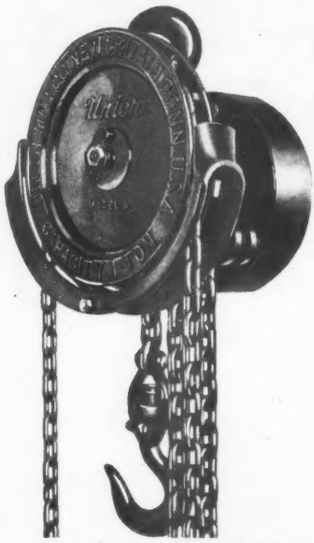
DETROIT MICH., U.S.A.
BRANCH OFFICES IN ALL PRINCIPAL CITIES

58-B

Union Hoists



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Pressed Steel Plate Construction
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Extremely Efficient

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Into these blue pencil rooms where salesmen seldom penetrate advertising goes whenever you choose to send it.

Because of this it sometimes pays to use widespread advertising to influence a comparatively small number of people. Though 95 per cent of the readers of the publication may never be in the market for your product, the value of reaching the other 5 per cent may be so great as to justify the cost.

[Published by The Railway Age in co-operation with The American Association of Advertising Agencies.]

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ONLY a few moments are required to set up and center a ROOKSBY PORTABLE BORING BAR.

The rapid set-ups are made possible through the aid of Quick Centering Blocks—a patented feature found only in a ROOKSBY BORING BAR.

Several other cost cutting features are incorporated in the ROOKSBY BAR—features that permit maximum speeds and therefore reduce machining time.

Our bulletins explain the details.

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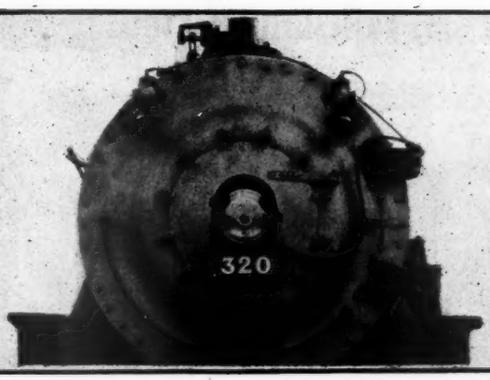
Manufacturers of Portable Tools for locomotives

1072 Hamilton St. Philadelphia, Pa.

ROOKSBY
Portable Tools



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MEXICAN Front End Lustre No. 320 does two important things to your front ends.

1. It enhances their appearance.
2. It prolongs their life.

It does these things by eliminating sulphur fumes, rust and scale. It is easily applied and each succeeding application adds to the smooth shining surface and to the durability of the metal.

Send for a trial application.

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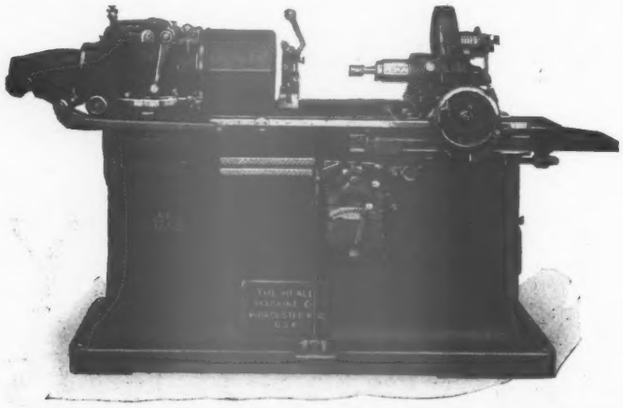
The added precision and accuracy obtained by this machine insures closer fits and retards the beginning of lost motion.

It also reduces material losses and increases production.



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Standard Electric Drills, Polishing, Grinding and Buffing Machines

Standard ¼-in. and 5-16-in. Heavy Duty Drills. Drills made in various sizes up to 1¼-in. capacity. General Electric Universal Motors used.

3-5-7½-10 and 15 H. P. G. E. 40° Motor. S. K. F. Ball Bearings.

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ROTO LOCOMOTIVE ARCH TUBE CLEANERS

Roto Air-driven Cleaner for 3" Locomotive Arch Tubes

"Exhibited at Booth IIA New York Power Show December 3rd to 8th, 1928"

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(TRADE-NAME REGISTERED THROUGHOUT THE WORLD)

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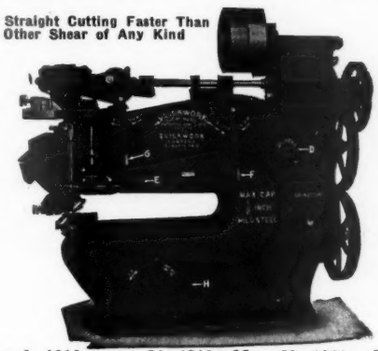

Pat. June 3, 1913; Aug. 26, 1919; Mar. 29, 1921. Other patents pending. One **"QUICKWORK"** does the work of a number of old style machines. Does it better and from two to ten times quicker.

Eliminate Oxy-acetylene Cutting and Plate Planing

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THOMPSON

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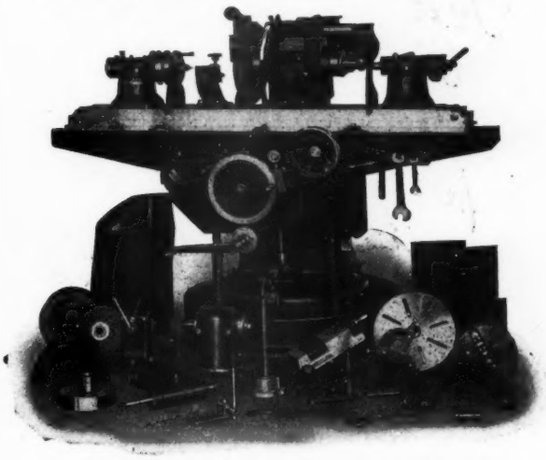

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MFG. BY

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1534 West Main Street

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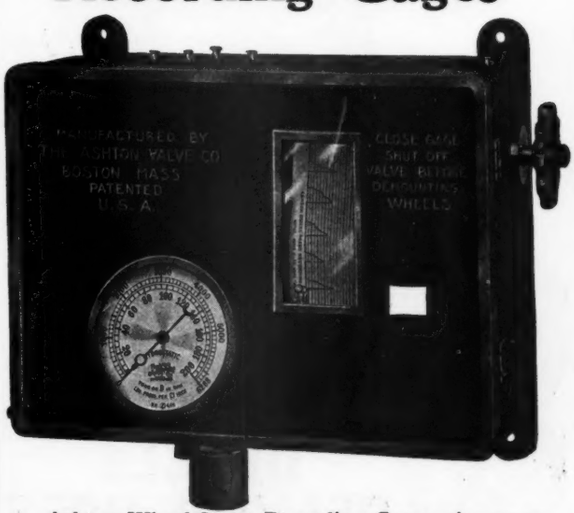
Ashton Wheel Press Recording Gages



Ashton Wheel Press Recording Gages give an accurate record of wheel fits on axles, showing actual fit from start to finish, insuring perfect mountings.

Send for special circular which gives full details, also catalogue describing our complete line of Specialties.

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~~1928~~

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A careful test will show you that this carefully processed, flame-tested and shop-tested wire gives better welding results at less cost. There is a grade for every need—each plainly marked for easy identification.
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PAGE-ARMCO
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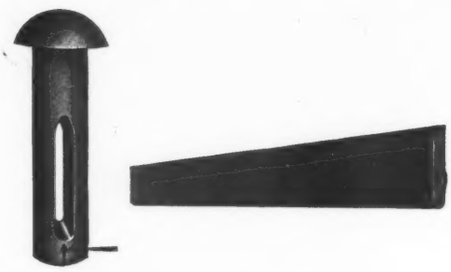
Welding Wire and Electrodes

REDUCE YOUR BOLTING EXPENSE ONE-HALF BY USING OUR

Special Fitting Up Bolts

ALL SIZES—ANY LENGTH



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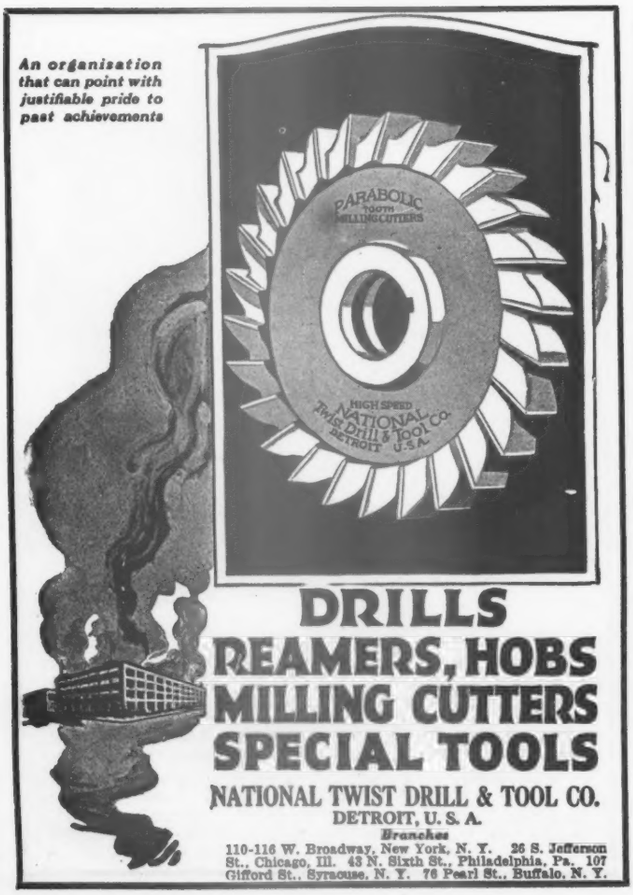

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STEEL + RIVETS = STRENGTH

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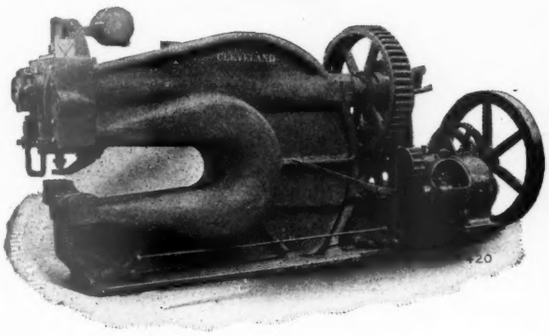

You stand the expense when your machines stand idle due to mechanical defects. When you buy *CLEVELAND* Fabricating Tools you have reduced that item to a minimum.

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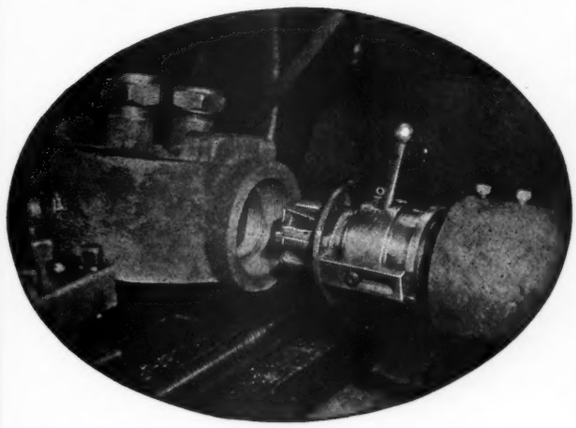

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Have you all the facts on the simple, positive, collapsing Tap? Remember it's a universal tool—quickly applicable to any standard machine without extra tripping or resetting parts. Catalog on request.

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Ask us for proof!

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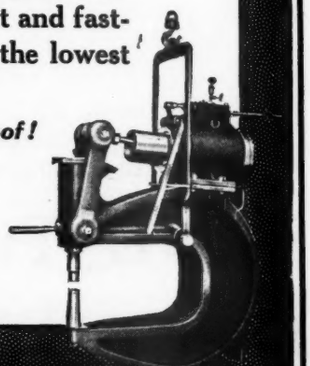

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One Sent On Request

Tell Us What Size You Want

The two bronze-to-bronze seats, ground together, make an accurate fit and eliminate all possibility of corrosion. Extra heavy malleable pipe ends surmounted by a heavy swivel tightening nut, make the Dart Union a single, unleaking unit. We'll be glad to send you a Dart Union FREE. Tell us what size you want.

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PROVIDENCE, R. I.
The Fairbanks Co., Sales Agents
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Big Jobs—

Are Easily Handled On A LUCAS

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The Lucas handles these heavy pieces with the same ease and dispatch that it does the small intricate parts.

It is this adaptability to all classes of work that makes the Lucas an invaluable machine wherever quick, accurate work is in demand.

For speed and economy in Boring, Drilling, Milling or all three combined, Lucas production invites your consideration.

We Also Make

The LUCAS Power Forcing Press

THE LUCAS MACHINE TOOL CO.

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Passenger car repairs on the Grand Trunk Western ..... **Page 683**

Repair shop at Port Huron, Mich., organized to turn out an average of 12 heavy-repair cars a month.

Getting back to fundamentals ..... **Page 697**

The Chicago & Alton has accomplished much by bringing back locomotive parts to conform with original blue print dimensions.

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NEW DEVICES:

A 64-in. by 60-in. planer-type milling machine 710
Tool for installing bottom outlet valve 712
Special micrometers for measuring forming tools 712
Standard vertical spindle milling machine 713
High speed portable electric drill 713
A 200-ampere d. c. arc-welding set 714
A horizontal boring and drilling machine 714
Portable grinder and buffer 715
Trimming press with steel side frames 715

NEWS OF THE MONTH 716

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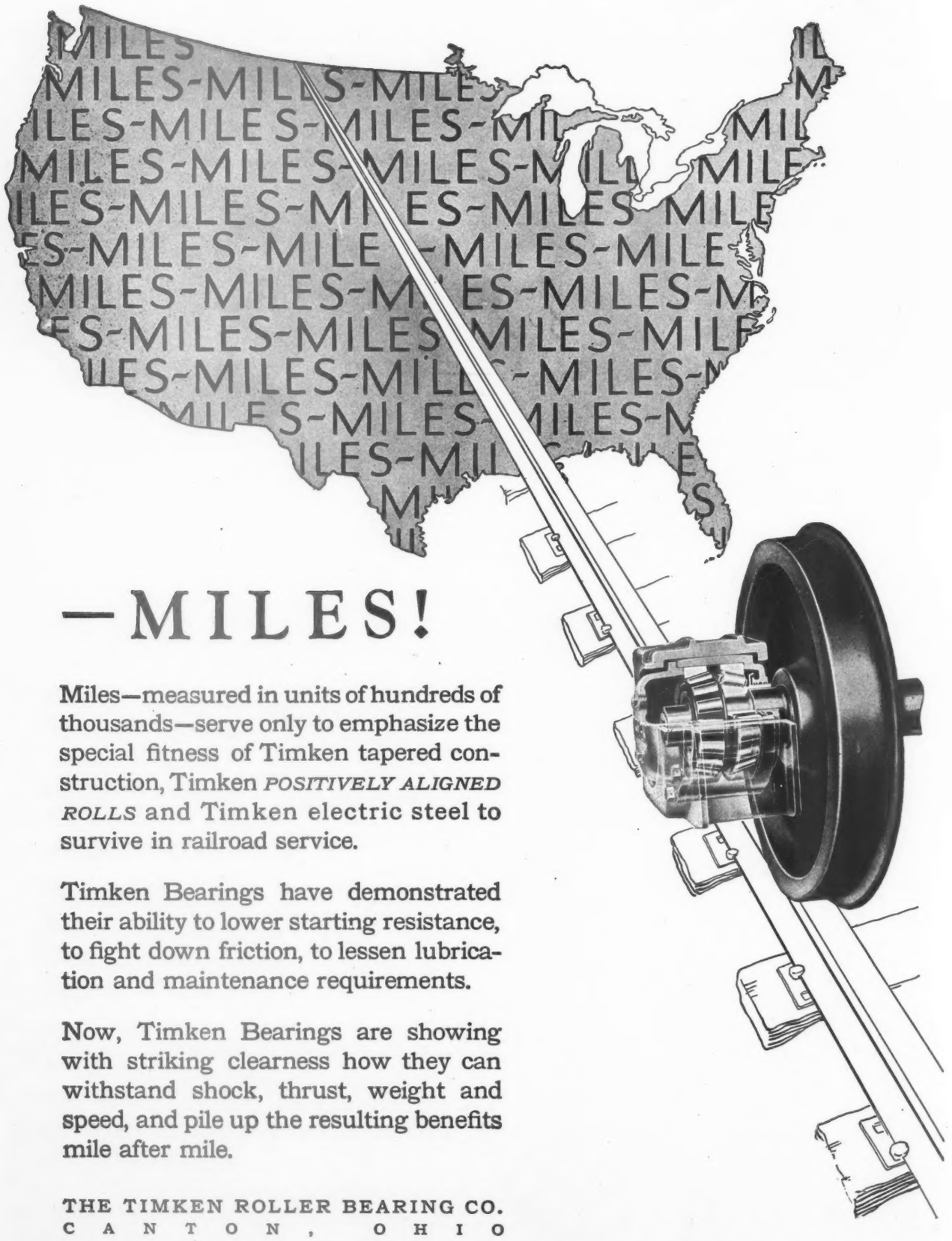
Request for change of address should reach the New York Office two weeks before the date of the issue with which it is to go into effect. It is difficult and often impossible to supply back numbers to replace those undelivered through failure to send advance notice. In sending us change of address, be sure to send us your old address as well as the new one.

Subscriptions, including the eight daily editions of the Railway Age published in June, in connection with the annual convention of the American Railway Association, Mechanical Division, payable in advance and postage free: United States, Canada and Mexico, $3.00 a year; foreign countries, not including daily editions of the Railway Age, $4.00.

The Railway Mechanical Engineer is a member of the Associated Business Papers (A. B. P.) and the Audit Bureau of Circulations (A. B. C.).



—MILES!

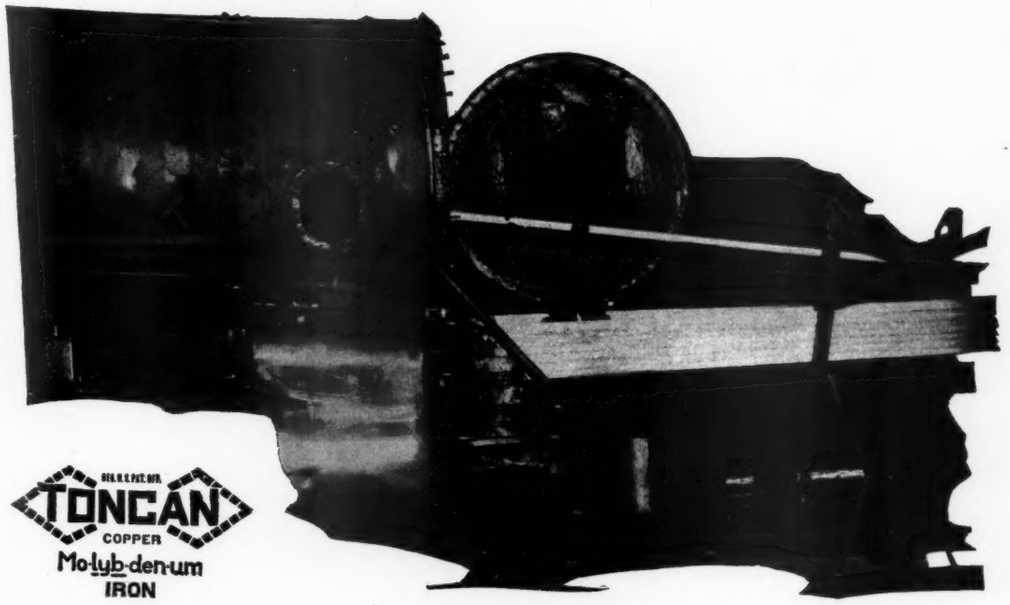
Miles—measured in units of hundreds of thousands—serve only to emphasize the special fitness of Timken tapered construction, Timken *POSITIVELY ALIGNED ROLLS* and Timken electric steel to survive in railroad service.

Timken Bearings have demonstrated their ability to lower starting resistance, to fight down friction, to lessen lubrication and maintenance requirements.

Now, Timken Bearings are showing with striking clearness how they can withstand shock, thrust, weight and speed, and pile up the resulting benefits mile after mile.

THE TIMKEN ROLLER BEARING CO.
CANTON, OHIO

TIMKEN *Tapered Roller* **BEARINGS**



TONCAN COPPER Mo-lyb-den-um IRON

TONCAN TUBES
Stand Up in Bad Water

"WE have had wonderful success with Toncan Iron boiler flues, in fact they have given us the best service without pitting in our worst water districts."

This is the comment of one Superintendent of Motive Power. His experience has been duplicated on many roads.

Toncan Iron boiler tubes not only have the natural corrosion resistance of iron fortified by the addition of copper and molybdenum, but they possess the further advantage of being seamless and easy to apply.

An iron tube that is seamless provides an ideal combination of qualities. Long life, no danger of splitting at the seam and due to a special characteristic of Toncan Iron, no danger of fire-cracking after the tube is cold-worked in applying it.

Toncan Iron tubes are the modern iron tubes. Try them wherever pitting and corrosion is troublesome.

Toncan Iron Tubes
Toncan Iron Rivets
Toncan Iron Staybolts
Toncan Iron Firebox Sheets
Agathon Alloy Steels For Locomotive Parts
Agathon Engine Bolt Steel
Agathon Staybolt Steel

CENTRAL ALLOY STEEL CORPORATION, *Massillon*, OHIO

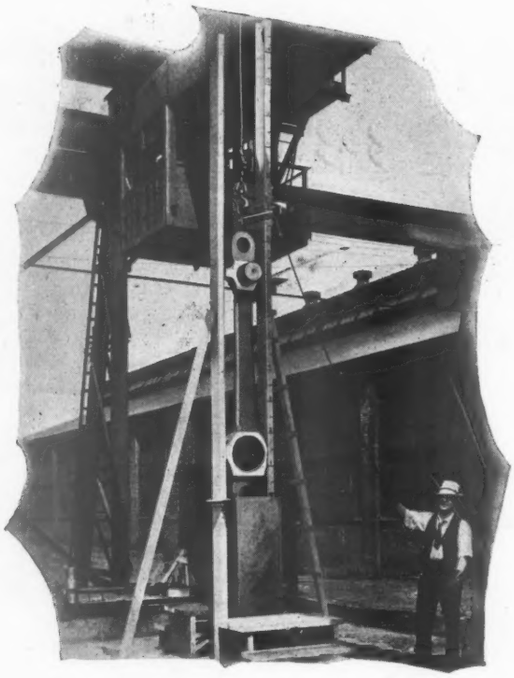
World's Largest and Most Highly Specialized Alloy Steel Producers

Makers of Agathon Alloy Steels

Cleveland Detroit Chicago New York St. Louis
Syracuse Philadelphia Los Angeles Tulsa
Cincinnati San Francisco Seattle

TONCAN COPPER MO-LYB-DEN-UM IRON

Lima Makes Sure of Rods



BY means of an original testing machine, all rods made by Lima are proved before they go into service.

A temporary pin is placed in the eye of the rod which is then raised in the guides to a predetermined height. When released, the rod drops, the pin taking the impact when it strikes the anvil below. The ring and rebound of the rod give the important indications of quality.

Thus, without exceeding the elastic limit of the metal, the slightest flaws or structural defects are sure to be found without risking an untried rod in service.

LIMA LOCOMOTIVE WORKS

Incorporated

Locomotive Maintenance Reduced By The Booster

The Locomotive Booster

LOCOMOTIVE maintenance is roughly proportional to the number of drivers.

Put a Locomotive Booster on a Mikado and it can do most of the things required of a 2-10-2 at an increased maintenance cost of half a cent per mile for the Booster as compared with a 5 to 10 per cent per mile increase when the extra pair of drivers is used.

When net operating income is considered, this saving of a few cents per mile becomes of great importance. It may not loom large in the operating ratio but it represents a big percentage increase in net.

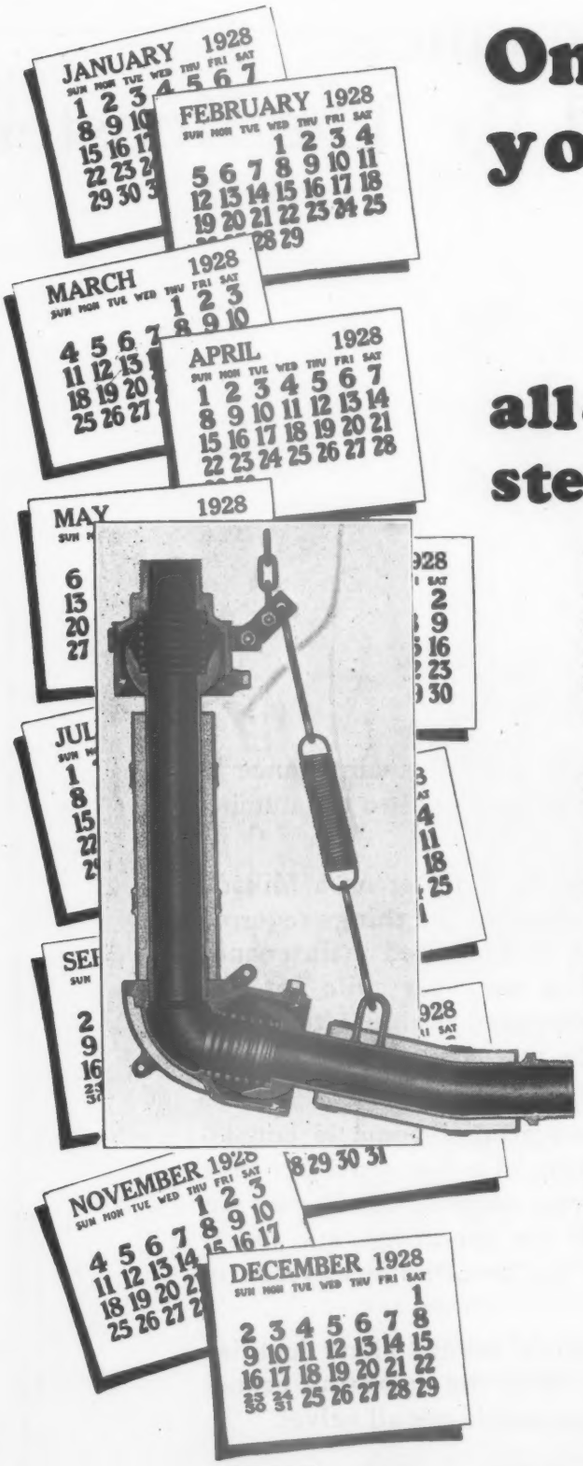
The maintenance saving alone justifies the Booster, while the operating economies it makes possible are all velvet.

FRANKLIN

RAILWAY SUPPLY COMPANY, INC.

The Locomotive Booster Capitalizes Idle Weight and Spare Steam

NEW YORK CHICAGO ST. LOUIS SAN FRANCISCO MONTREAL



Only once a year—you service your BARCO

all-metal insulated car steam heat connections

PUT new gaskets in your Barco car steam heat connections before the winter heating season opens. Then forget them for a year. The gaskets are good for a full season's service. They cannot blow out nor fail suddenly.

Barco connections have been in use for ten years. Their record proves their dependability. The well-known Barco ball joint used in these connections is in service on practically every Class I railroad. You take no chances when you equip with Barco connections.

The friction loss is low because all sharp turns and 90 deg. bends have been eliminated. Full area is provided in all positions. Radiation loss is low because the connections are fully insulated. These features insure passenger comfort in any weather with minimum maintenance and without emergency repairs.

There is still time to equip with Barco steam heat connections for the coming season—from the locomotive to the last car. Ask for a Barco representative.

BARCO MANUFACTURING COMPANY
1801 Winnemac Avenue Chicago, Ill.

The Holden Co., Ltd.

In Canada
Montreal, Moncton, Toronto

In Canada
Winnipeg, Vancouver

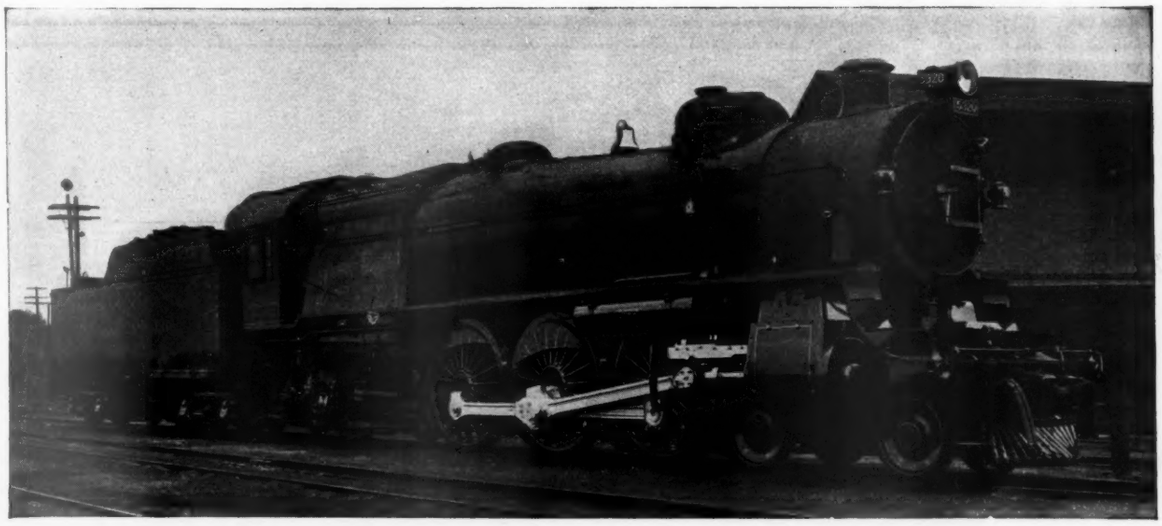
BARCO Railway Devices

RME 12-Gray

Correct Steam Distribution

PLUS

Boiler Capacity



A STRIKING example of this combination is found in the passenger locomotive "President Cleveland," on the Baltimore & Ohio Railroad, which incorporates in its design the Caprotti Poppet Valve Gear and a Water-tube Firebox Boiler.

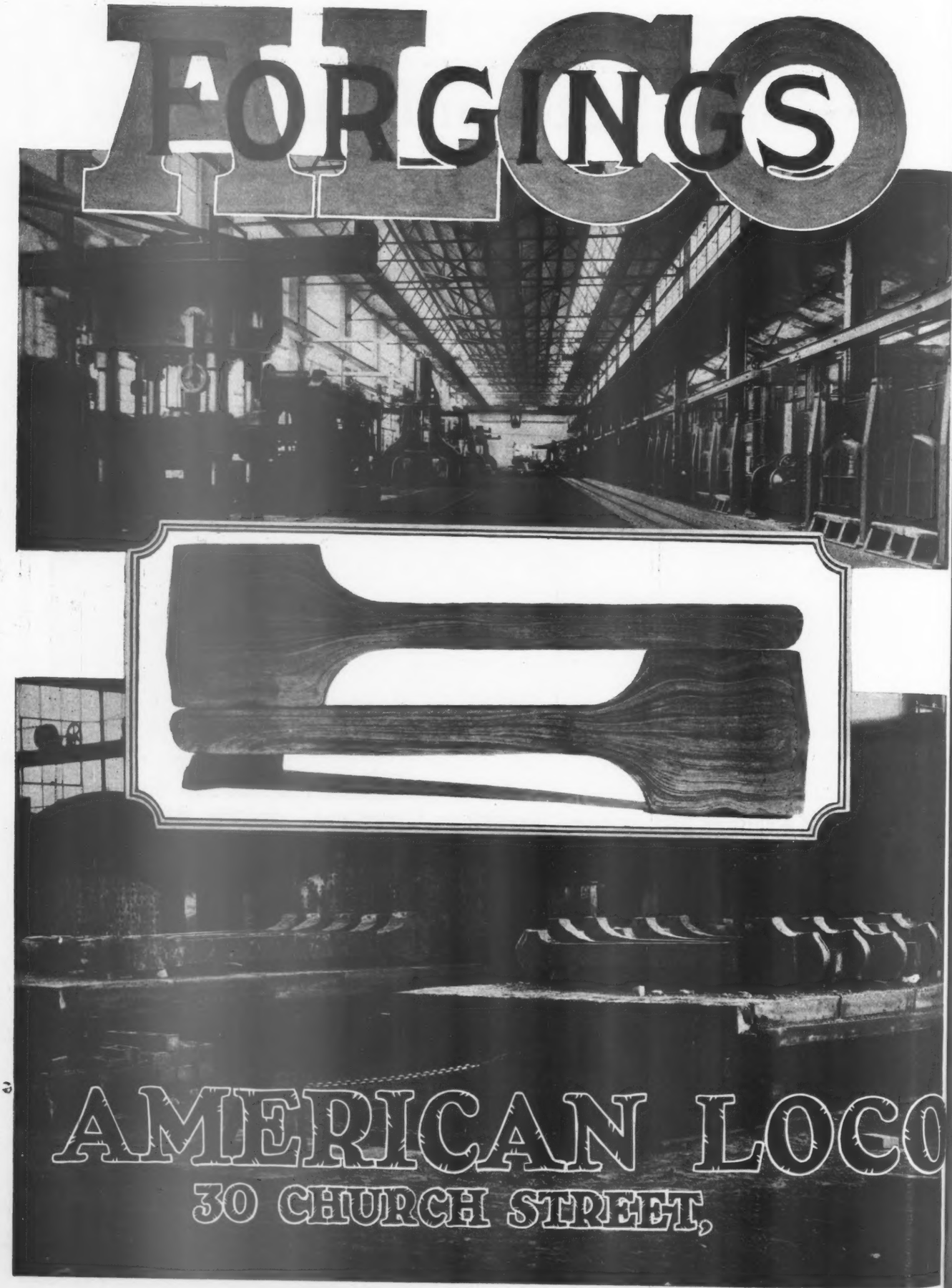
This locomotive, in express passenger service, shows upwards of 20 per cent saving in fuel per car mile as compared with locomotives of conventional design in service on the same division.

The Caprotti Valve Gear was furnished by

THE BALDWIN LOCOMOTIVE WORKS

Licensee under Caprotti Patents

PHILADELPHIA


ALCO
FORGINGS
AMERICAN LOCO
30 CHURCH STREET,

THERE IS MORE THAN STEEL IN ALCO FORGINGS

IT is comparatively only in recent years that locomotive forgings have received the manufacturing attention required to insure that inbuilt quality which modern power demands.

Again, the search for true economy has led straight back to quality.

There can be no compromise with quality in forgings. It has been proven unmistakably that getting the most for the fewest maintenance dollars is possible only when forgings embody that extra measure of dependability which makes for long life in hard service.

But aside from the maintenance feature, there is another factor that should be given due consideration. The profit earning capacity of the modern locomotive of today is too great to be jeopardized by the use of any other than the best forgings obtainable.

Consider these advantages when your locomotives go into the shop if you expect real sustained service when they are again on the road, for Alco forgings will provide a failure indemnity which continues the economy of any particular device, feature, or the better utilization of the locomotive itself.

Alco forging shop facilities are unsurpassed in men, methods and equipment. These could not be duplicated in any railroad shop except at a prohibitive cost.

MOTIVE COMPANY

NEW YORK CITY

Being one of the series of forging talks in the Railway Mechanical Engineer.

55 TON FRAME
GOULD A. R. A. DESIGN

SPRINGS—A. R. A. CAPACITY 64000 LBS.

RESULTS OF FIVE SERIES OF TESTS

VERTICAL

	★Present A.R.A. Spec.	Highest R.R. Spec.	Test
Deflection at 95,000 lbs.	.063	.035	.0365 .0370 .0410 .0350 .0375
		Average	.0374
Set after 185,000 lbs.	.031	.010	.0110 .0160 .0175 .0095 .0135
		Average	.0135
Ultimate Load	360000	500000	506000 470000 529000 543000 503000
		Average	510200
Elastic Limit		170000	182000 164000 187000 172000 182000
		Average	177400

FATIGUE

	Highest R.R. Spec.	Test
Loads for Start of First Critical Crack	Min. for 1 Frame 25000 Avg. of 4 Frames 50000	114500 121700 83500 115218 189900
	Average	124964
Loads for Complete Failure		208773 178600 115995 208037 246961
	Average	191673

TRANSVERSE

	★Present A.R.A. Spec.	Highest R.R. Spec.	Test
Deflection at 29,000 lbs.	.094	.060	.0585 .0575 .0600 .0615 .0650
		Average	.0605
Set after 53,000 lbs.	.031	.010	.0120 .0045 .0250 .0170 .0190
		Average	.0155

GOULD

HIGH CAPACITY

A.R.A. DESIGN FRAME

USED IN THESE TESTS

AVERAGE WEIGHT 615 LBS.

★ A.R.A. Specifications in process of revision.

ALL FRAMES USED IN THESE

THE GOULD

Works: Depew, N. Y. NEW YORK CHICAGO BALTIMORE

COMPARISON
SYMINGTON DOUBLE TRUSS

INCREASED SPRING CAPACITY 89000 LBS.

RESULTS OF FIVE SERIES OF TESTS

VERTICAL

	★Present A.R.A. Spec.	Highest R.R. Spec.	Test
Deflection at 95,000 lbs.	.063	.035	.0345 .0345 .0340 .0345 .0360
		Average	.0347
Set after 185,000 lbs.	.031	.010	.0055 .0050 .0025 .0060 .0050
		Average	.0048
Ultimate Load	360000	500000	550000 549000 568000 535000 567000
		Average	553800
Elastic Limit		170000	210000 222000 242000 214000 228000
		Average	223200

TRANSVERSE

	★Present A.R.A. Spec.	Highest R.R. Spec.	Test
Deflection at 29,000 lbs.	.094	.060	.0540 .0580 .0595 .0600 .0590
		Average	.0581
Set after 53,000 lbs.	.031	.010	.0070 .0100 .0090 .0125 .0070
		Average	.0091

FATIGUE

	Highest R.R. Spec.	Test
Loads for Start of First Critical Crack	Min. for 1 Frame 25000 Avg. of 4 Frames 50000	186000 142500 137160 144000 189400
	Average	159812
Loads for Complete Failure		289000 184900 247075 180400 283928
	Average	237060

SYMINGTON

INCREASED SPRING CAPACITY

DOUBLE TRUSS FRAME

USED IN THESE TESTS

AVERAGE WEIGHT 609 LBS.

TESTS MANUFACTURED BY

COUPLER CO.

ST. LOUIS SAN FRANCISCO Adanac Supplies, Ltd., Montreal

★ A.R.A. Specifications in process of revision

The *new* Type "S"

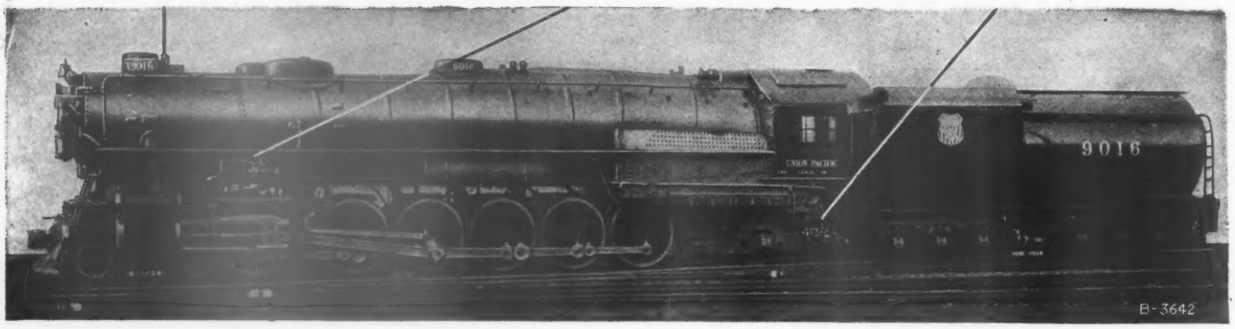
Worthington Locomotive Feedwater Heater

saves and distributes weight

Type "S" Open Feedwater Heater

Type "S" Direct-acting Hot-water Pump

Type "S" Turbine-driven Centrifugal Cold-water Pump



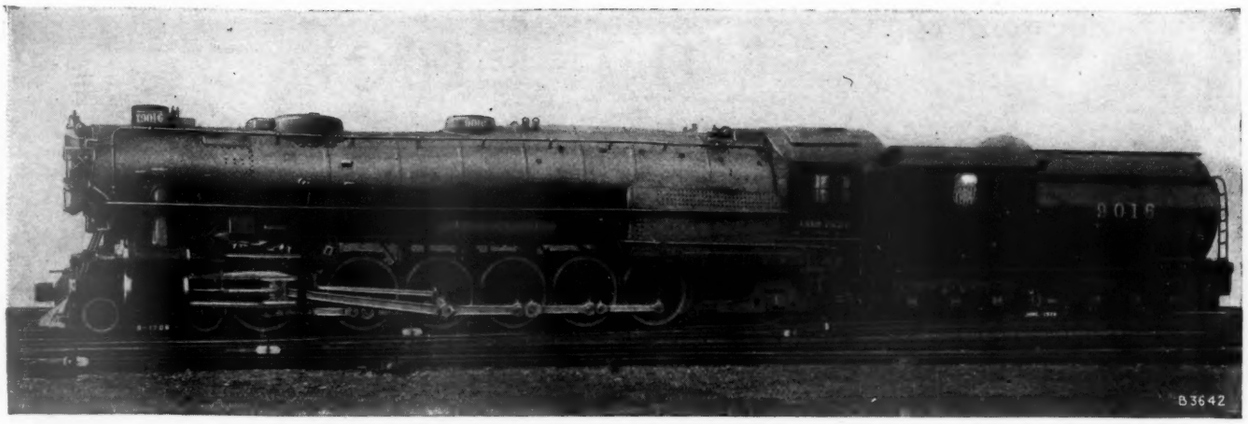
THE Worthington Type "S" equipment gives the high efficiency of the open type feedwater heater with IDEAL WEIGHT DISTRIBUTION

★ ★ ★ ★

WORTHINGTON
PRODUCTS
PUMPS
COMPRESSORS
CONDENSERS
and Auxiliaries
OIL *and* GAS ENGINES
FEEDWATER HEATERS
WATER *and* OIL METERS
Literature on Request

WORTHINGTON PUMP AND MACHINERY CORPORATION, 2 PARK AVENUE, NEW YORK · DISTRICT OFFICES IN 24 CITIES

WORTHINGTON



Union Pacific 4-12-2 Type Locomotive built by American Locomotive Company in 1928, equipped with Worthington Type S Locomotive Feedwater Heater.

The first

of 23 Union Pacific 4-12-2 type locomotives equipped with the WORTHINGTON TYPE S LOCOMOTIVE HEATER went into service June 25, 1928.

To date the operation of 23 Type S Heaters on new power and 19 on existing power has been entirely satisfactory.

PUMPS
COMPRESSORS
CONDENSERS *and Auxiliaries*

WORTHINGTON
PRODUCTS
Literature on request

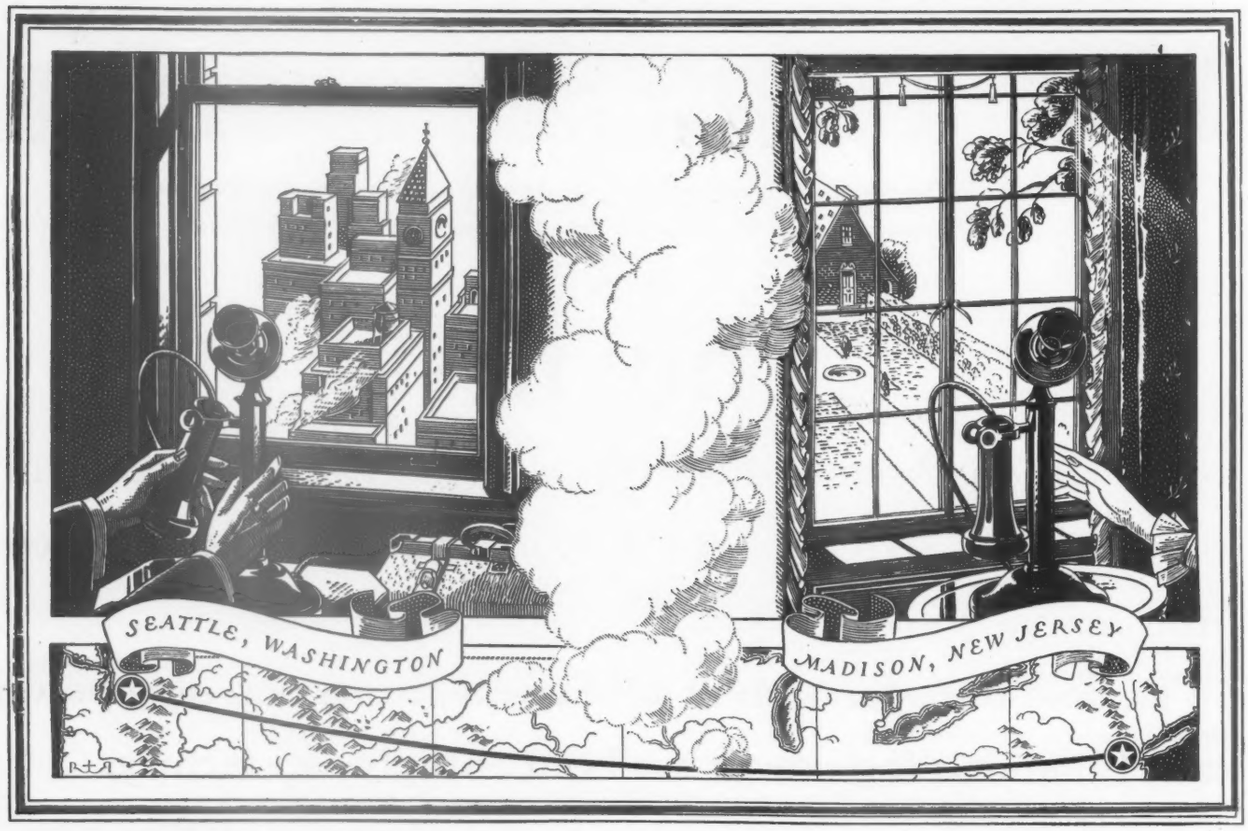
OIL *and* GAS ENGINES
FEEDWATER HEATERS
WATER *and* OIL METERS

WORTHINGTON PUMP AND MACHINERY CORPORATION, 2 PARK AVENUE, NEW YORK ◥ DISTRICT OFFICES IN 24 CITIES

WORTHINGTON

7441-15

"Setting Free the Mind as by a Miracle"



An Advertisement for Bell Long Distance Telephone Service

IN SEATTLE, Washington, far from home. Homesick. Lingering doubts and apprehension about the welfare of his family in Madison, N. J., 3000 miles away.

He filed a telephone call, and a few minutes later the operator signaled.

A crisp, "Go ahead, please!" and then across the plains, mountains and valleys came to him the reassuring tones of a familiar voice.

"Setting free the human mind as by a miracle," is how this man describes long distance calls.

And business doubts are banished just as quickly. Whether in business or personal matters, telephone calls will quickly clear the worries off your desk and out of your mind. You will be surprised how little long distance calls cost.

Under the new station to station day rates, Los Angeles to Chicago is only $6.25. Denver to St. Louis, $3.50. Miami to Atlanta, $2.80. Dallas to New Orleans, $2.20. Pittsburgh to Cleveland, 80c. Atlantic City to New York, 70c. Baltimore to Philadelphia, 70c. What distant calls could you make to advantage, now?

The station to station day rate from the Statue of Liberty to the Golden Gate is only $9.00. . . . Calling by number takes less time. . . . . *Number, please?*

"Safety Control" Feature for Rail Motor Cars

OPERATION of rail motor cars may now have an additional safeguard by virtue of the "Safety Control" feature recently developed by the Westinghouse Air Brake Company.

This feature, which is similar to that being used on several thousand street cars, provides for automatic stopping of the car if the operator becomes physically disabled.

It comprehends the interlocking of car control and brakes in such a way that if the operator takes his hand from the brake valve without first having built up a predetermined cylinder pressure, the power is shut off and an emergency brake application made.

We recommend that this valuable feature be incorporated in new gas rail car equipments. Moreover, many railroads are changing present equipments to provide for the advantages of safety control.

A Brake Application Valve serves to vent brake pipe pressure; the Brake Valve embodies a pilot valve which actuates the Brake Application Valve; an Automatic Control Switch is used in the engine ignition system to automatically interrupt the source of power; a Cut Off Valve automatically renders the safety control features inoperative when a brake application has been made; and a Foot Valve permits the operator to remove his hand from the brake valve handle without actuating the safety features when desired.

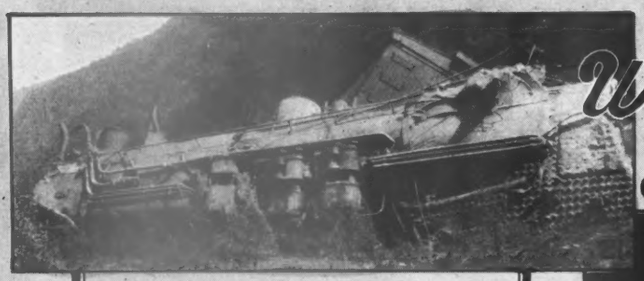
WESTINGHOUSE AIR BRAKE CO.

General Office and Works, Wilmerding, Pa.

New York Washington Pittsburgh Chicago St. Louis San Francisco

SYPHONS

Avoid Severe Low Water Accidents



Without Syphons

IN this accident, due to low water, three men were killed and heavy financial loss was sustained. The cost of one low water accident such as this would equip many locomotives with syphons — and syphons pay back their own cost over and over again.

With Syphons

TYPICAL case of low water in a Syphon equipped locomotive. The water in this boiler was 5 inches below the crown sheet, yet with water spreading over the crown, due to syphon action, the damage was slight with no fatalities.

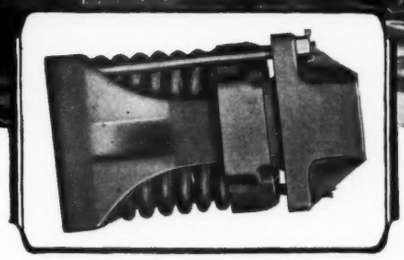
Syphons for *all* your Power

LOCOMOTIVE FIREBOX COMPANY

MONTREAL CHICAGO NEW YORK

"The Heart of the Locomotive"

Damaged in Transit!



National M-17 Draft Gear

REDUCE
These Claims

LESS and less often the costly words "Damaged in Transit" appear in claims. Better packaging and more careful handling all along the line deserve part of the credit.

But railroad men know that lading is safer today than it was ten years ago because of better equipment and — better draft gears.

National Draft Gears are designed to provide maximum protection to cars and valuable lading — to increase operating profits by reducing claims and repair bills.

NACO Steel
Trademark Registered

The castings for every National Naco Steel Draft Gear are heat treated in electrically operated and controlled furnaces. Uniform results are secured by this method.

THE NATIONAL MALLEABLE & STEEL CASTINGS CO.
General Offices: Cleveland, Ohio
Sales Offices: New York, Philadelphia, Washington, Chicago, St. Louis, San Francisco.
Works: Cleveland, Chicago, Indianapolis, Sharon, Pa., Melrose Park, Ill.

NATIONAL
ELECTRIC NACO STEEL
DRAFT GEARS

CONTROL

SPLIT second control that prevents damage, reduces claims, delays and maintenance cost is the function of National Power Brakes on freight cars.

These brakes were especially designed to meet modern railroad requirements, heavy loads and rapid handling. They are rugged in construction and powerful in action, developing a force well over A.R.A. requirements for hand brakes.

They eliminate the auxiliary levers and sheave wheels which cause frictional losses.

THE NATIONAL MALLEABLE & STEEL CASTINGS CO.
General Offices: Cleveland, Ohio
Sales Offices: New York, Philadelphia, Washington, Chicago, St. Louis, San Francisco.
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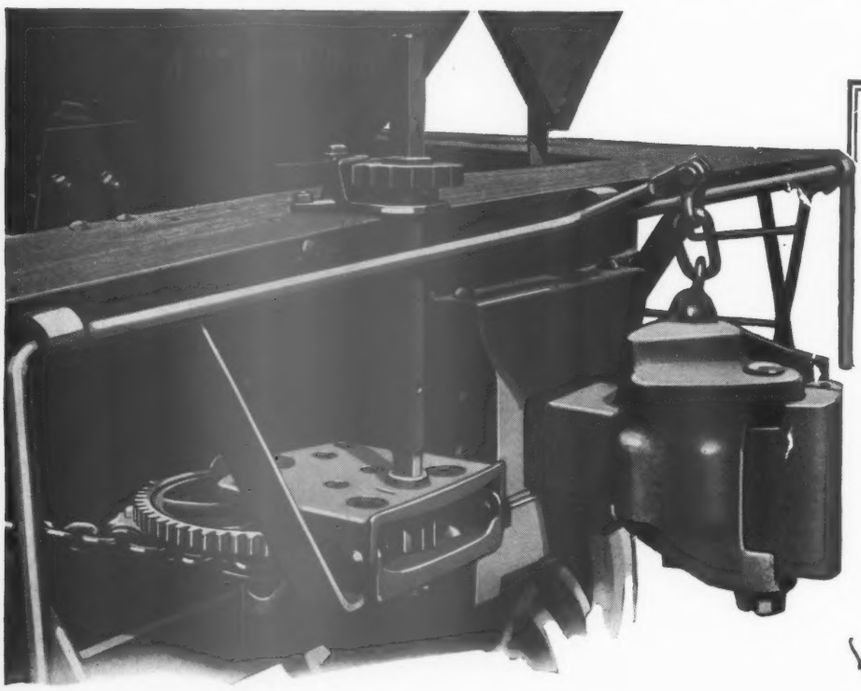


Above cut-away illustration of Cam Gear Brake shows pinion lever leaving the cam slot and the first tooth of the drum gear being engaged by the pinion teeth. The cam is designed so that there is always a positive engagement between pinion and gear — and no abrupt shock in the transfer from the cam to the teeth can occur. The National Cam Gear Brake develops a force at the brake cylinder push rod well in excess of the required 3950 pounds, without the use of a club.

NATIONAL
POWER
HAND BRAKE

The well known ounce of prevention

Alloy steels—the proper alloy steels—used in the proper places in locomotive construction will reduce repairs tremendously. Do not build so as to make repairs easily—build to make repairs unnecessary. Every ounce of an alloy steel will be an ounce of prevention.

INTERSTATE IRON & STEEL CO.
104 South Michigan Avenue
CHICAGO

Interstate Alloy Steels

Open Hearth Alloy Steel Ingots, Billets
Bars, Wire Rods, Wire, Nails, Cut Tacks
Iron Bars and Railroad Tie Plates

DISTRICT OFFICES: New York, 52 Vanderbilt Ave.; Detroit, Washington Boulevard Building; Milwaukee, First Wisconsin National Bank Bldg.; St. Paul, Merchants National Bank Building; St. Louis, International Life Building; Kansas City, Reliance Building

The B.-A. Co.

BLOW OFF COCKS

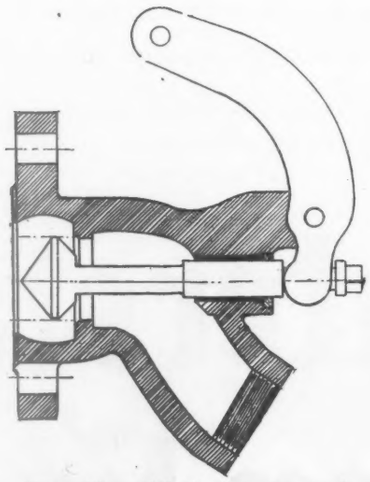
FLANGE

SCREW

Patented 1920

Can be ground under boiler pressure with wrench.

Non-freezable as valve is in mud ring.



Baco Blow-Off Cock to be used with internal piping system

Only Three Working Parts.

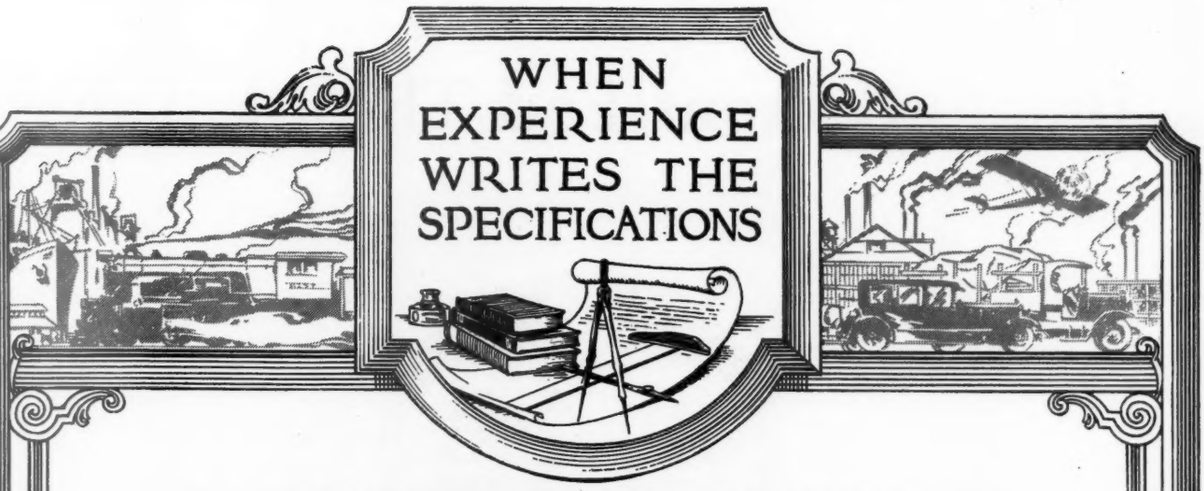
A cleaner, as it draws water and scale along mud ring and not away from the inside sheet.

This Company is engaged primarily in the manufacture and supply of Boiler Chemicals for water treatment. Its activities in rendering the necessary expert service in this connection, are properly extended to cover the installation and service of B.-A. Co. Blow Off Cocks. These items are all consistently designed to obtain one end: The promotion of Locomotive Boiler Efficiency.

THE BIRD-ARCHER COMPANY

NEW YORK

PHILADELPHIA CHICAGO BUENOS AIRES Argentina ST. LOUIS MANILA P. I. MONTREAL SYDNEY Australia WINNIPEG



The PENNSYLVANIA RAILROAD

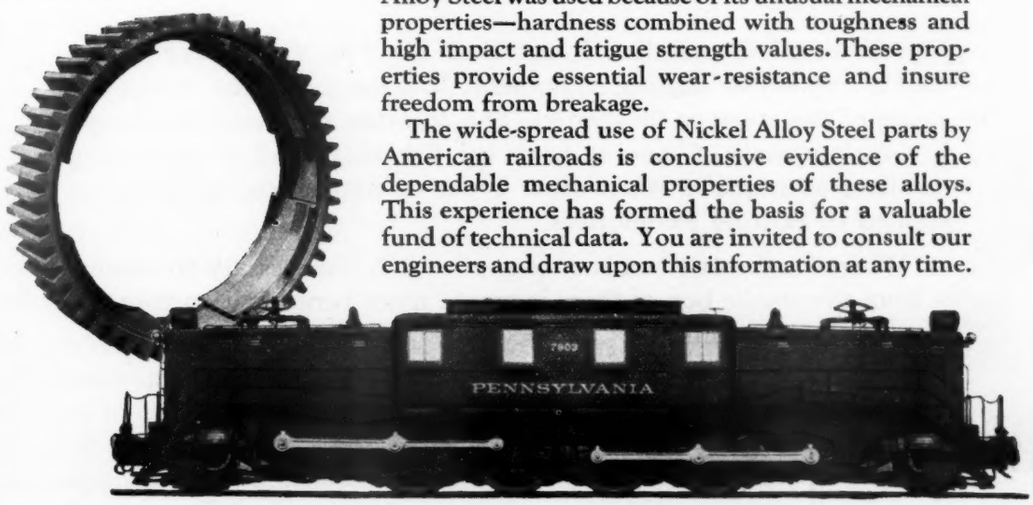
Uses Nickel Chromium Steel for Driving Gears in Electric Locomotives

PULLING heavily loaded passenger trains back and forth between Manhattan Transfer and Pennsylvania Station—maintaining regular 24-hour schedules year in and year out—the electric locomotives of the Pennsylvania Railroad must be built to furnish unfailing power and at the same time, to withstand hard, continuous service.

Seven of these new electric locomotives are equipped with Nickel Chromium Steel driving gears. Nickel Alloy Steel was used because of its unusual mechanical properties—hardness combined with toughness and high impact and fatigue strength values. These properties provide essential wear-resistance and insure freedom from breakage.

The wide-spread use of Nickel Alloy Steel parts by American railroads is conclusive evidence of the dependable mechanical properties of these alloys. This experience has formed the basis for a valuable fund of technical data. You are invited to consult our engineers and draw upon this information at any time.

Nickel Chromium Steel electric locomotive drive gear. Weldless forged ring furnished by MITCHELL STEEL CO., Cincinnati, Ohio. Teeth cut by Niles Tool Works, Hamilton, Ohio.



Pennsylvania Railroad electric locomotive equipped with Nickel Steel driving gears

Send for "Buyers' Guide to Nickel Alloy Steel Products"

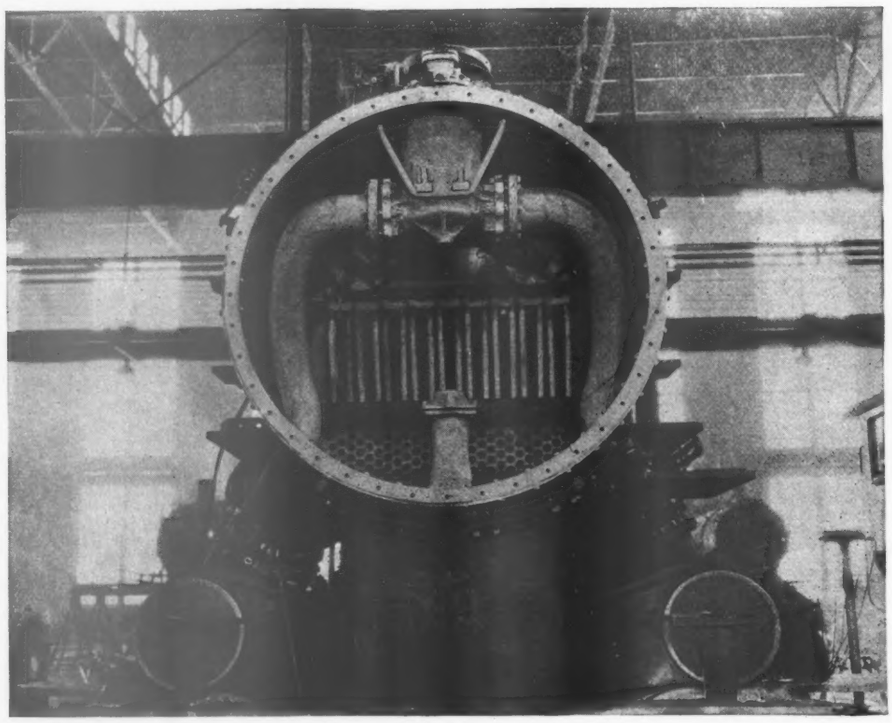
FOR STRENGTH WHERE THE STRESS COMES
NICKEL STEEL

Nickel
FOR ALLOY STEEL

List of available publications on Nickel and its alloys furnished on request. Send for it!

THE INTERNATIONAL NICKEL COMPANY (INC.), 67 WALL STREET, NEW YORK, N. Y.

Bradford Front End Throttle Valve



Typical Application of Bradford Front End Throttle Valve—Type A

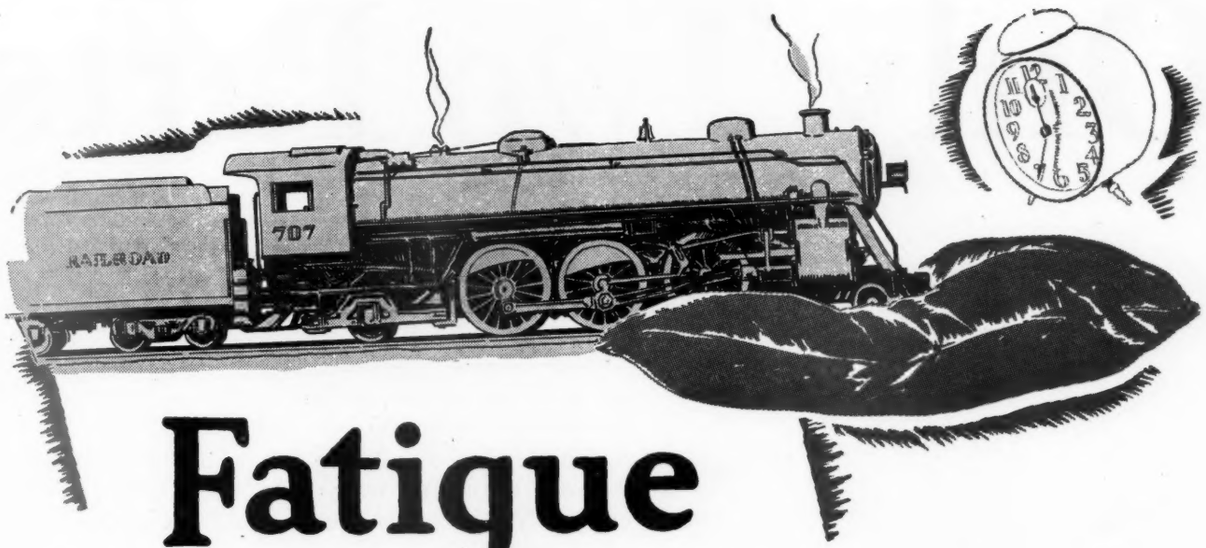
The Bradford Locomotive Front End Throttle Valve, Type A, is readily applied to existing equipment. It is located in the smoke box ahead of the stack as illustrated. This location eliminates the necessity and expense of moving back the flue sheet and of shortening the flues as required when other types of smoke box throttles are applied to existing locomotives.

When the throttle box is once applied it is unnecessary to remove it from the smoke box as there is ample space beneath it to take out the superheater units.

BRADFORD
MANUFACTURERS
of
BRADFORD DRAFT GEARS; DRAFT ARMS and CENTER SILL CONSTRUCTIONS
THROTTLE VALVES
HUNTOON TRUCK BOLSTERS and BRAKE BEAMS
TRUSS ROD BRAKE BEAMS

THE BRADFORD CORPORATION

25 WEST FORTY-THIRD STREET NEW YORK
RAILWAY EXCHANGE CHICAGO



Fatigue

It "*gets*" locomotives, too!

BY a system of aches and pains and a marvelous co-ordination of nerve fibres, the human body is counseled to take rest from "fatigue." Nature, in time, restores its vitality. Not so, however, with the maintenance of train service. No delicately sensitive instrument registers fatigue of vital parts, such as the pipe system. And you can't put a locomotive to bed every night. And if you could, no amount of rest would restore the metal, which has become fatigued, to its original usefulness.

The modern demands for safety and uninterrupted service have led many railroads to use only the most dependable material and equipment. For vital air and steam lines, genuine wrought iron pipe is being specified in greater quantity than ever before. Railroad men know that Byers wrought iron pipe, while costing a fraction more than ordinary pipe when installed, can be depended upon to give many times the service of ordinary pipe. It helps to reduce the number of breakdowns due to pipe failure, by its peculiar ability to resist fatigue and corrosion.

The advantages of wrought iron pipe of Byers manufacture are described in a treatise on the subject entitled "Pipe Failures in Railway Service," a copy of which will be gladly supplied on request. The coupon is for your convenience.

A. M. BYERS COMPANY
Established 1864
PITTSBURGH, PA.

COUPON

A. M. BYERS CO.,
R. R. Div., Pittsburgh, Pa.

Gentlemen: Kindly send me a copy of your Bulletin No. 44, entitled "Pipe Failures in Railway Service." No obligation.

Name .....

Address .....

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BYERS PIPE

GENUINE WROUGHT IRON

Only Two Parts

THE Support Arm and Interlocking Gib are the only parts that you have to handle when applying or renewing a DAVIS SUPPORT ARM. There are no bolts, rivets, nuts or cotters to work loose and cause trouble—the sliding malleable iron shoes cannot become detached from the Support Arm and their design accommodates any type of trussed brake beam.

The renewal of brake beams is a simple job on cars that are equipped with DAVIS SUPPORTS—so easy that no repair man would avoid replacing the supports.

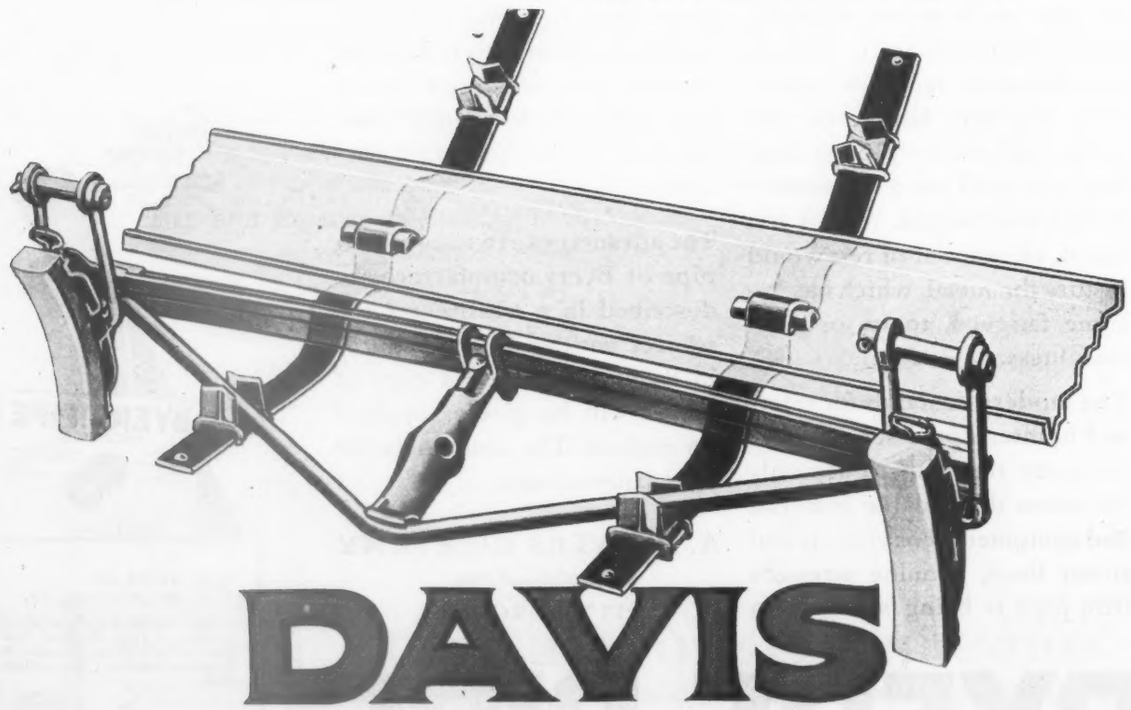
Why worry along with those improvised safety guards that are so difficult to apply and remove? DAVIS SUPPORTS will reduce your brake beam renewal costs and also increase the mileage of brake shoes and all brake beam wearing parts.

Spring Steel Support Arm
Steel Interlocking Gib.
Illustration below shows how these two simple parts of the DAVIS SUPPORT are fitted to the spring plank.

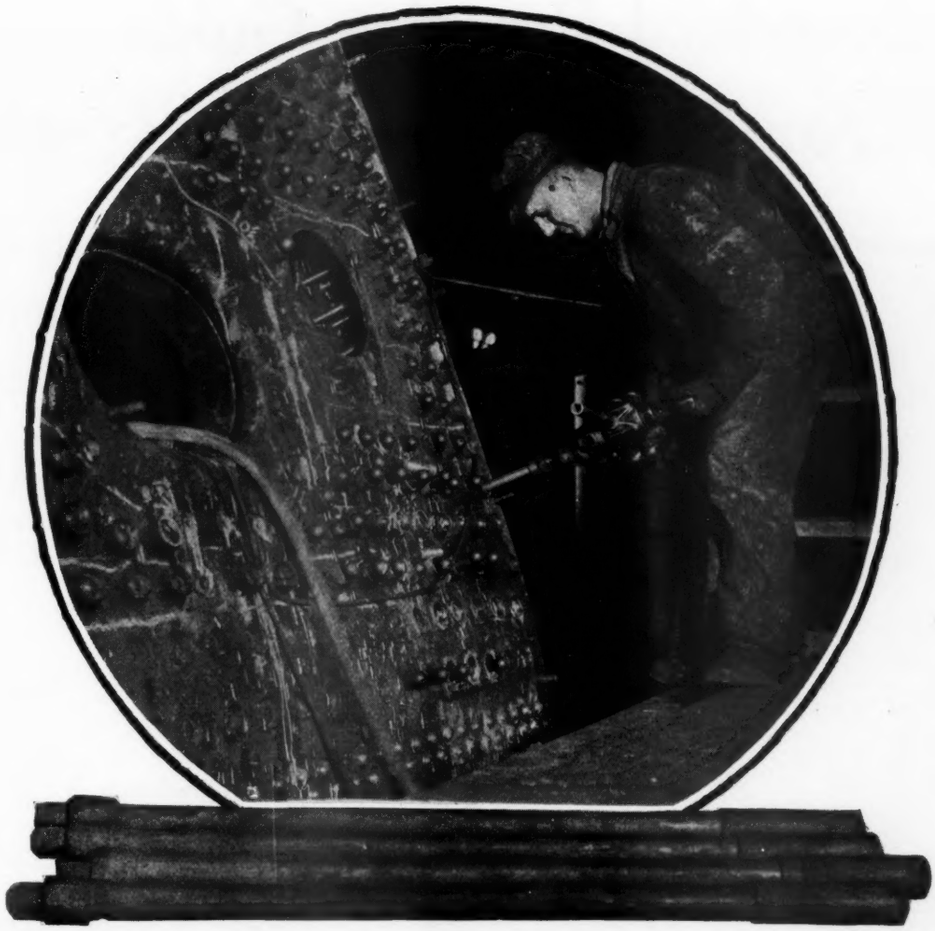
They also insure greater safety.

DAVIS BRAKE BEAM COMPANY
JOHNSTOWN, PA.

General Sales Office: 418 Sixth Ave., Pittsburgh, Pa.
Chicago Office: 122 South Michigan Ave.



DAVIS
Brake Beam Supports



More "Staying" Qualities

STAYBOLTS made of BURDEN IRON possess all of those physical properties necessary to withstand the tremendous strains of present day service.

Over one hundred years of iron making experience has resulted in a super-refining process which defies duplication.

BURDEN IRON contains no dirt or mixture of steel—it is free from blisters and burned edges—it will not split during the driving operation.

If you are searching for better staybolts you will find more "staying" qualities in those made from BURDEN IRON.

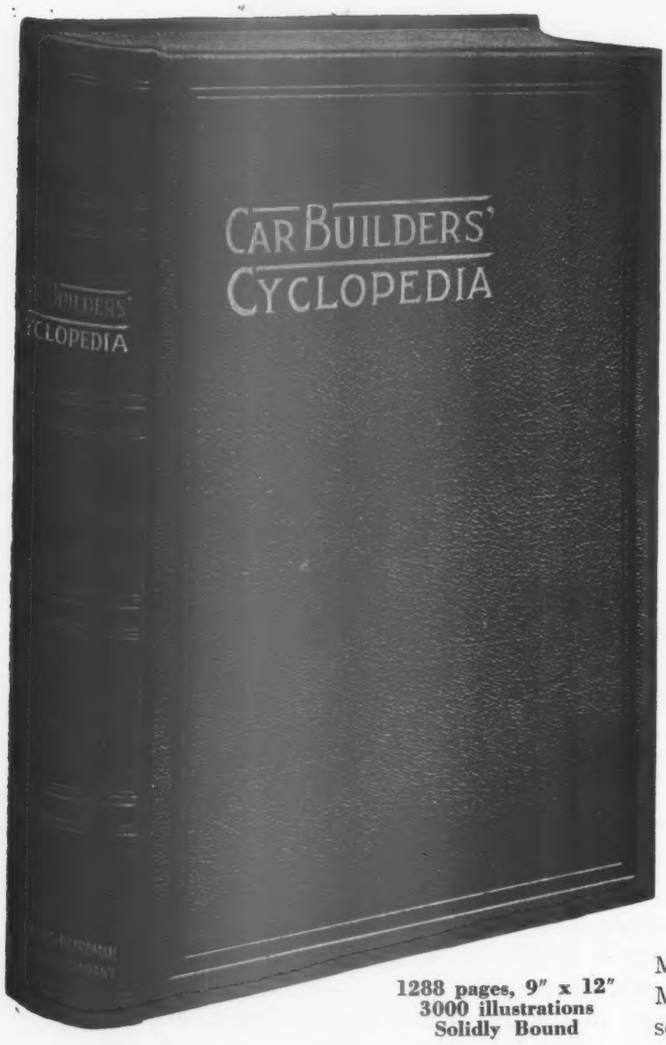
The Burden Iron Company

Troy, New York, N. Y. — New York, Chicago, Ill.

Burden Iron

Makes Better Staybolts

The Standard Practice Guide *for* Car Department Executives



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Complete information on all the newest efficiency methods of keeping rolling stock in top notch condition is graphically presented in this well-known work. Valuable data on the use of the most modern equipment, of cost-cutting and time-saving machines, is herein assembled and arranged for your convenience. This book will help you order tools that exactly meet your every requirement.

Edited by Roy V. Wright, Editor of RAILWAY MECHANICAL ENGINEER, and compiled for the Mechanical Division of the AMERICAN RAILWAY ASSOCIATION, this work is the authority in its field. It contains the new designs of cars and appliances in railway car construction during the past three years, as well as the time tested standard equipment. Complete indexes make the vast store of valuable information in this book readily accessible

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It is understood that I have the privilege of returning this book at the end of 10 days at your expense if I am not absolutely satisfied. However, if I decide to keep the book I will remit the price of $7.00 at that time.

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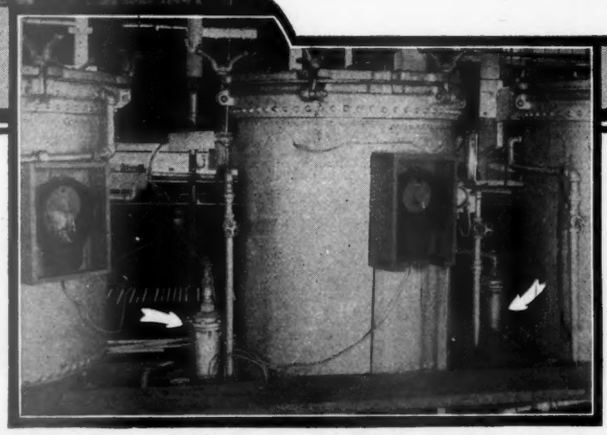
Use Armstrong steam traps WHEREVER steam is used

ARMSTRONG TRAPS are saving fuel and guarding steam lines and equipment in thousands of power and industrial plants, railway shops, large office buildings—and wherever steam is used.

Their unique construction gives a small sized trap for a large capacity. That accounts for their low cost. The small size simplifies installation. They fit into any small convenient space and ordinarily require no other support than the pipe line in which they are installed. Air does not affect their operation. They discharge entrapped air with the condensate. The positive operation of the valve—either wide open or tightly closed—and the self-scrubbing feature reduce maintenance to a minimum. They are efficient and economical.

There is a type and size of Armstrong Trap for every draining problem. Send for an Armstrong, and test it 90 days at our expense. It will pay dividends during test period. Then return it if you are not thoroughly satisfied. *Mail the coupon now.*

ARMSTRONG MACHINE WORKS
338 Maple Street, Three Rivers, Mich.
District Representatives in 36 Cities



ARMSTRONG MACHINE WORKS
338 Maple St., Three Rivers, Mich.
Please ship prepaid an Armstrong Trap for a 90-day test. When the test is completed we will return the trap collect

For service on.....

Size of pipe.....Steam Pressure (Maximum).....

Name and Position.....

Firm.....

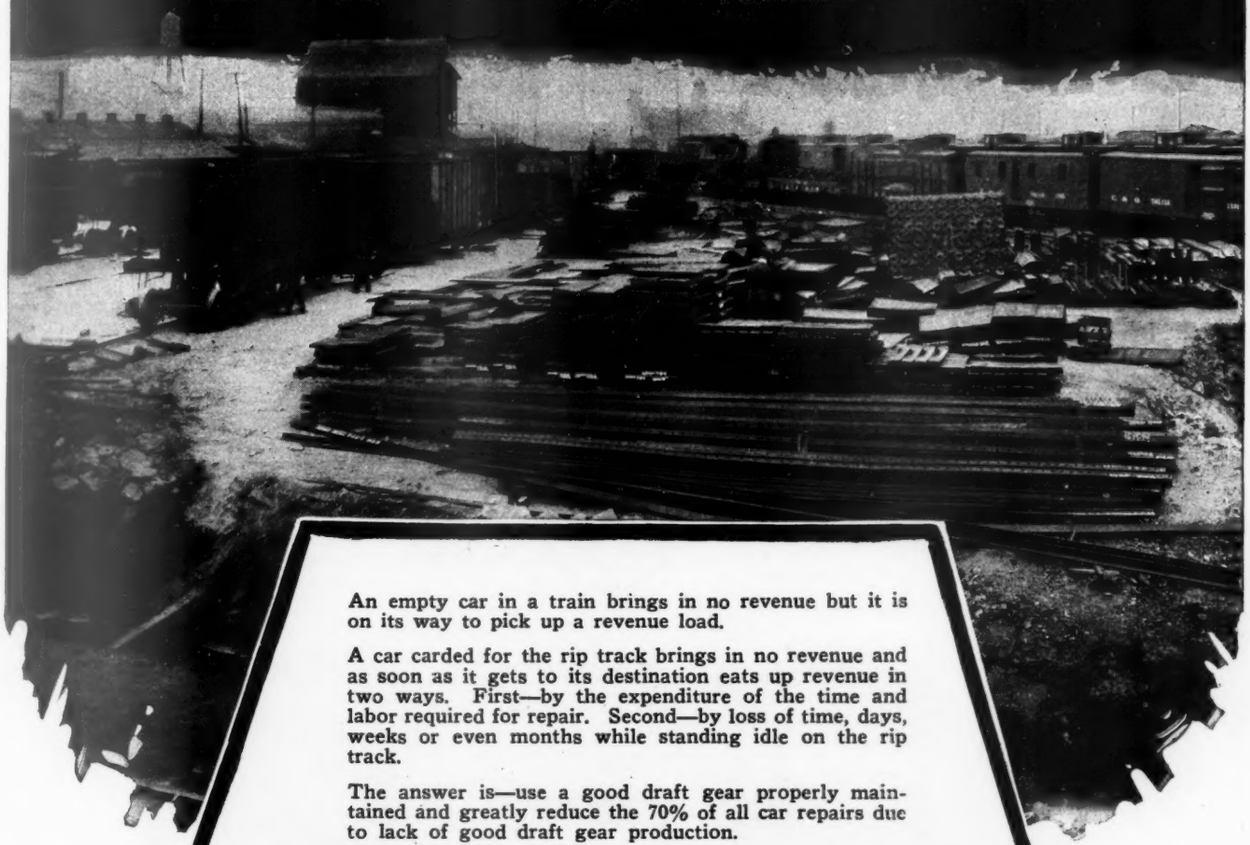
Street Address.....

City and State.....

☐ Send Catalog. RME 12-Gray

ANNUAL
ROLL
CALL

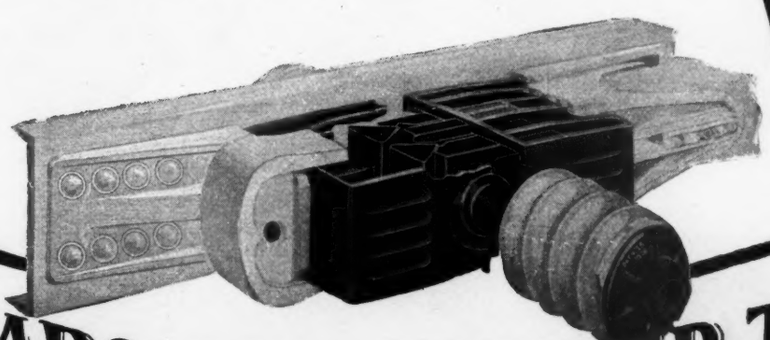
RIP TRACK MILEAGE IS WORSE THAN EMPTY CAR MILEAGE



An empty car in a train brings in no revenue but it is on its way to pick up a revenue load.

A car carded for the rip track brings in no revenue and as soon as it gets to its destination eats up revenue in two ways. First—by the expenditure of the time and labor required for repair. Second—by loss of time, days, weeks or even months while standing idle on the rip track.

The answer is—use a good draft gear properly maintained and greatly reduce the 70% of all car repairs due to lack of good draft gear production.



KEEP CARS OFF THE RIP TRACK

USE CARDWELL DOUBLE "A" SPECIAL DRAFT GEAR

UNION DRAFT GEAR CO. CHICAGO MONTREAL

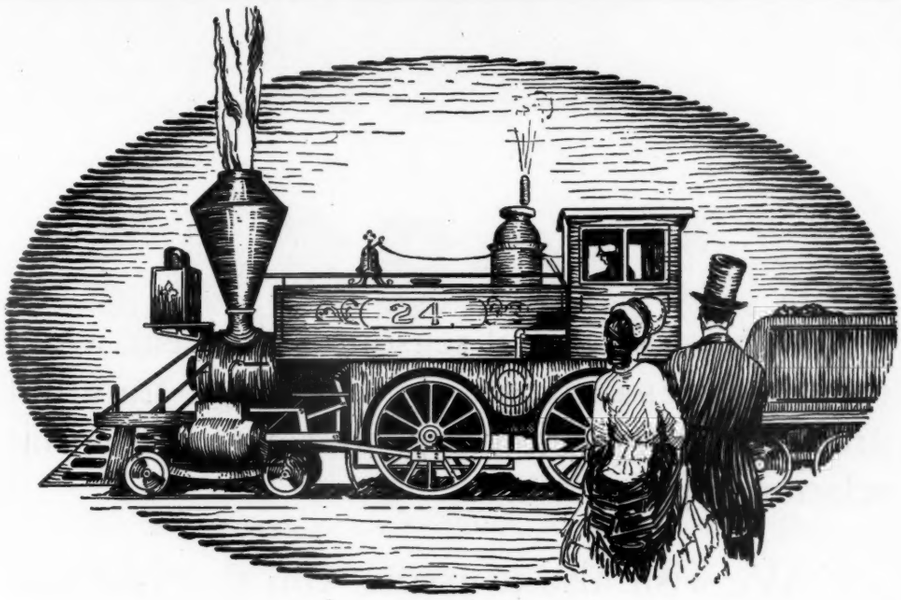
RAILWAY SPECIALTIES

ANDREWS, VULCAN, INTEGRAL BOX AND DALMAN TRUCKS

CAST STEEL TRUCK BOLSTERS

AMERICAN STEEL FOUNDRIES

NEW YORK CHICAGO ST. LOUIS



"Good enough for Father—" *but today ~~~*

Yes, today is different. The "iron horse" has been put away with the mustache cup, the congress gaiters—and is occasionally brought out on exhibition to amuse us—to impress upon us the remarkable progress made through the past decades.

Today is the day of Steel. Great passenger trains rush across the continent bearing their precious human freight—safeguarded by steel. Steel rails, steel wheels, steel axles—steel for every item of equipment of which unusual safety and durability are demanded.

And now the latest is "fast freight." These splendid freight trains, some of them proudly boasting a name, run on a schedule that not so long ago would have been the envy of passenger service. Their increased speed, however, presents a new problem. It is essential that wheel failures be eliminated.

Carnegie Light Weight Wrought Steel Wheels, designed for freight cars with a maximum journal of 5½" x 10", are the solution. Their use places freight service on the same safety basis as passenger service. They require no contour reconditioning. They cost less per mile than any other type of wheel available for light freight service. Nearly 300,000 are now in service, just three years after their introduction—proof of the fact that they are living up to the advantages claimed for them.

Our wheel engineers will gladly discuss the subject with you.

CARNEGIE STEEL COMPANY

Subsidiary of UNITED STATES STEEL CORPORATION

General Offices: Carnegie Building

PITTSBURGH, PA.

1941

THIS is a special season of the year when business pauses to exchange fraternal greetings, good fellowship, and cement cordial relationships.

We wish also to assure you that our best endeavors will be to maintain always that quality and service which has given character to the

In extending sincere and hearty Christmas Greetings to all, we covet for you an abundance of the best things in life, and may the coming year bring health, increased wisdom and happiness.

The J. B. Ford Co. **Wyandotte, Michigan**

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THE SUPER CUTTING TOOL

The first important contribution to the art of cutting tools since the introduction of high speed steel.

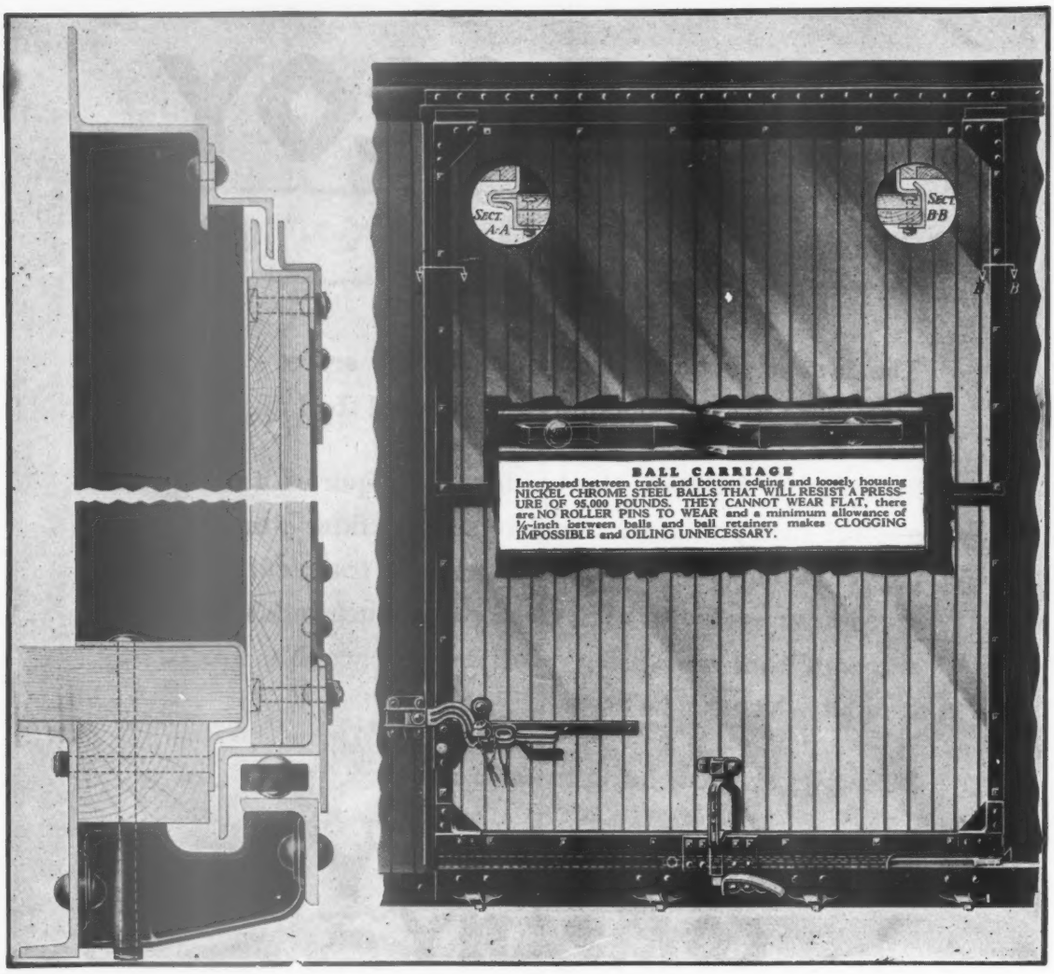
In order to facilitate the handling of inquiries it is requested that you give complete specifications—material to be machined—use on what machine tool; cut, feed, speed now used with high speed steel; blueprint showing shape of tool now being used; largest possible size of tool bit which can be used.

Deliveries are now being made in rotation.

CARBOLOY COMPANY INC
350 MADISON AVE., NEW YORK

Speed Production with CARBOLOY

THE BALL BEARING CAR DOOR


SECT. A-A
SECT. B-B
BALL CARRIAGE
Interposed between track and bottom edging and loosely housing NICKEL CHROME STEEL BALLS THAT WILL RESIST A PRESSURE OF 95,000 POUNDS. THEY CANNOT WEAR FLAT, there are NO ROLLER PINS TO WEAR and a minimum allowance of ½-inch between balls and ball retainers makes CLOGGING IMPOSSIBLE and OILING UNNECESSARY.

It Eliminates

FRICTION
DAMAGED GUIDES
FLATTENED ROLLERS
NECESSITY OF OILING
PILFERING
BROKEN HANGERS
WEAR OF ROLLER PINS
"BUTTING" IN TRANSIT
SNOW AND ICE FROM THE TRACK
UNSATISFACTORY OPERATION DUE TO INACCURATE MACHINING
UNSATISFACTORY OPERATION DUE TO CORROSION

MANUFACTURED and SOLD
IN BOTH TOP HUNG AND BOTTOM SUPPORTED TYPES BY THE

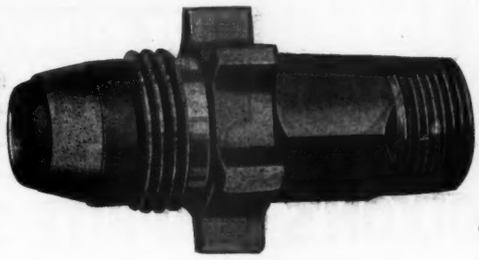
CHICAGO RAILWAY EQUIPMENT COMPANY

CHICAGO, ILLINOIS

Stop Those Air Leaks

with the LOWREY COUPLING

male or female end furnished for either hose or pipe connection.



A simple and positive connection—no springs or locking teeth of uncertain tension.

Most couplings are so designed that when once snapped together tney are as tight as they will ever be, and frequently develop leaks after the gasket has taken a permanent set. The Lowrey Hose Coupling is so constructed that the pressure on the gasket can be increased at any time by simply turning the swivel nut. There are no springs or locking teeth of uncertain tension.

The gasket in the LOWREY hose coupling is a plain, inexpensive rubber washer which sets in a tapered position over the male end and is forced against the shoulder in the female end when the swivel nut is turned. Any wear on the gasket can be taken up at any time by a little further turn of the swivel nut. The gasket cannot be blown or lost off when couplings are disconnected.

Sold Exclusively by

Gustin-Bacon Manufacturing Co.

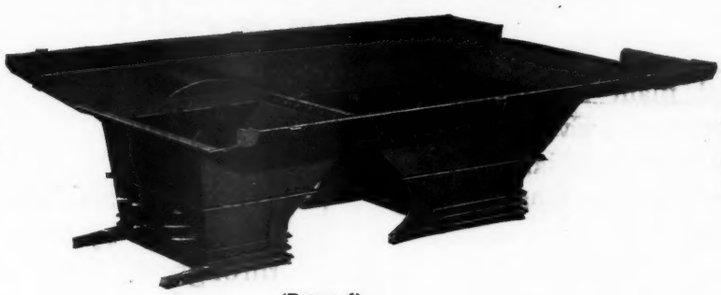
Kansas City Chicago Philadelphia

COMMONWEALTH

Cast Steel—Ash Pan—Double Hopper

Saves Maintenance Expense

Arranged for either swing or sliding hopper doors.



(Patented)

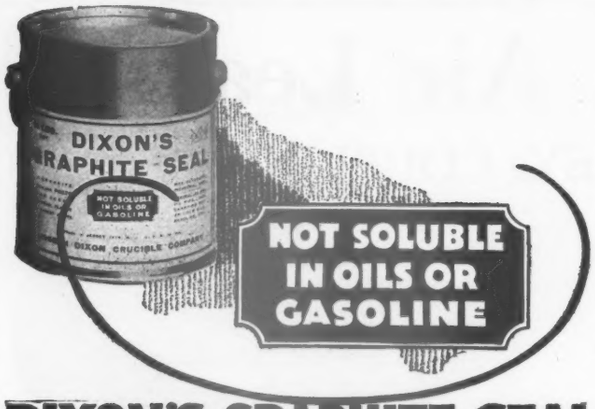
Number of parts reduced to a minimum.

In Service on more than Five Thousand Locomotives.

Manufacturers of Cast Steel Fire Pans for Oil-Burning Locomotives

COMMONWEALTH STEEL COMPANY

Granite City, Illinois



DIXON'S GRAPHITE SEAL

for any point where there is no water present

DIXON'S Graphite Seal fills a long felt need for a sealing paste that would *effectively seal* tank hand-hole and man-hole plates: air, vacuum, gas, vapor, and high pressure steam lines; cylinder heads, oil burners, gasoline engines, Diesel engines, turbines, generators, pumps and similar equipment used to handle mineral, animal and vegetable oils. It is not to be used on water lines.

It makes a screw thread, flange or gasket joint tight . . . sealed . . . and is not soluble in hot or cold oils, gasoline and similar solutions.

Every industrial plant has numerous uses for this product. Every maintenance man should be familiar with its ability to make joints *leak-proof and permanently tight.*

The full story is in Circular No. 7 DS a copy of which is yours for the asking.

JOSEPH DIXON CRUCIBLE COMPANY

Jersey City New Jersey

Established 1827

MEASUREMENT of VALUE

Superheaters
Feed Water Heaters
Exhaust Steam Injectors

The value of these devices is measured by the difference in the cost of operating locomotives with them and without them.

Write for literature.

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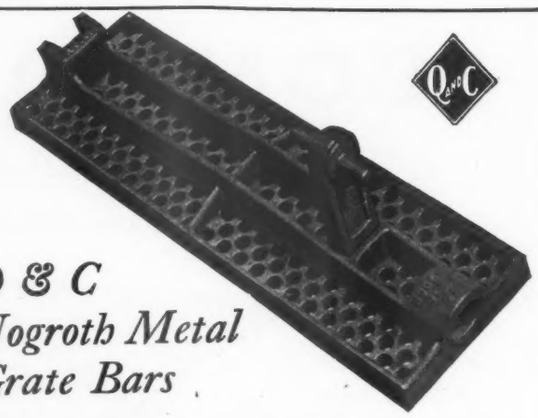
17 East 42nd Street NEW YORK (ELESCO) **Peoples Gas Bldg. CHICAGO**

Canada: THE SUPERHEATER COMPANY, Ltd., Montreal

For detailed description see Locomotive Cyclopedia



Q & C Nogroth Metal Grate Bars

Q & C Nogroth Metal Grate Bars are being used by many of the railroads throughout the country, effecting large fuel economies. Fire box weights can be reduced from 20 to 30%. They are interchangeable with the ordinary cast iron bar now in general use.

We will be glad to furnish blue prints and detailed information on request.

The Q & C COMPANY, 90 West St., New York

CHICAGO SAN FRANCISCO ST. LOUIS

FLANNERY TWO-PIECE ASSEMBLAGE

Eight years service has definitely and positively proven the merits of the Flannery Tell-Tale Bolt—of its function of daily—constantly—indicating its own condition.

The Flannery TWO-PIECE Assemblage, incorporating this bolt, provides all of its safety and economic advantages, *at approximately the same cost* as you have been paying for the old Tate solid bolt with the three piece assemblage.

Can you afford to be without the protection of the Tell-Tale Bolt?

Especially so when it can be secured *without additional cost?*

FLANNERY BOLT COMPANY

Flannery Building Pittsburgh, Pa.

MULE-HIDE ROOFS

A New Product!

MULE-HIDE *Cab Curtain Canvas*

What it is.

Heavy duck, made from hard twisted cotton yarns thoroughly saturated with a special asphaltic compound.

What it does.

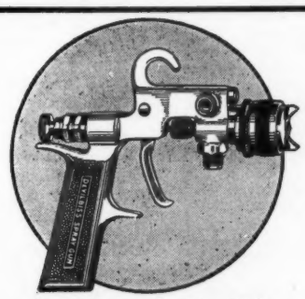
Wears much longer. Improves the appearance of engine cab because it is plain black and does not get "spotty" from grease and dirt. Won't rot and resists fire.

What they say.

Users declare unanimously that they would never go back to the old plain duck curtain.

The Lehon Company,

W. 44th. to 45th. St. on Oakley Avenue.
Chicago Illinois.



Leadership of Varied and Comprehensive Experience

In 20 years of developing spray-painting methods and equipment for all industries and groups having painting or surface maintenance problems, the DeVilbiss organization has learned much that is of value to those concerned with the painting of rolling stock and railroad buildings and equipment. We will gladly tell you how DeVilbiss spray systems are saving money and property for railroads, and help you select suitable outfits for your particular needs.

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DeVilbiss
Spray-PAINTING FINISHING System

BUYERS INDEX

For location of advertisements of manufacturers listed in the Buyers Index, see Alphabetical Index on the last page next to cover

Accumulators, Hydraulic
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Niles Bement Pond Co.
United Engineering & Foundry Co.
Watson-Stillman Co., The.
Wood & Co., R. D.

Acetylene Welding Rods and Wire — (See Welding Rods and Wire).

Air Compressors—See Compressors, Air).

Air Conditioning.
American Blower Corp.

Air Drills—(See Drilling Machines, Portable Pneumatic).

Air Hammers—(See Hammers, Pneumatic).

Air Hoists—(See Hoists, Air)

Air Hose—(See Hose, Air).

Air Lifts.
Ingersoll-Rand Co.
Sullivan Machinery Co.

Air Pump Cleaners
Oakite Products, Inc.

Air Reservoir Joints — (See Joints, Air Reservoir).

Anchors, Brake Pipe
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Ingersoll Milling Machine Co., The.
McCrosky Tool Corp.

Arch Tube Cleaners — (See Tube Cleaners).

Arch Tubes.
National Tube Co.

Arrestors, Electric.
General Electric Co.

Ash Pans, Cast Steel.
Commonwealth Steel Co.

Automatic Chucking and Turning Machines—(See Lathes, Automatic Chucking and Turning).

Automatic Connectors—(See Connectors, Automatic).

Automatic Milling Machines —(See Milling Machines, Automatic).

Automatic Screw Drivers — (See Screw Drivers, Automatic).

Automatic Screw Machines—(See Screw Machines, Automatic).

Axles, Car and Locomotive.
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Lima Locomotive Works.

Banding Presses, Hydraulic—(See Presses, Banding).

Bars, Boring — (See Boring Bars).

Bars, Concrete, Reinforcing.
Carnegie Steel Co.
Interstate Iron & Steel Co.

Bars, Iron and Steel.
Burden Iron Co.
Carnegie Steel Co.
Timken Roller Bearings Co.

Beading Machines
Quickwork Co., The.

Bearings, Axle, Generator.
S. K. F. Industries
Timken Roller Bearing Co.

Bearings, Ball.
S. K. F. Industries

Bearings, Ball Thrust
S. K. F. Industries

Bearings, Car.
American Steel Foundries.

Bearings, Center
American Steel Foundries.
Chicago Ry. Equipment Co.
National Malleable and Steel Castings Co.
S. K. F. Industries
Symington Co., The.

Bearings Roller.
Timken Roller Bearing Co.

Bearings, Side
American Steel Foundries.
Chicago Ry. Equipment Co.
Q. & C. Co., The.
Wine Railway Appliance Co.

Bearings, Tabered Roller
Timken Roller Bearing Co.

Bearings, Thrust
Timken Roller Bearing Co.

Belt Dressing.
Bowser & Co., Inc., S. F.
Dixon Crucible Co., Jos.

Belt Headers.
National Machinery Co. The.

Bench Legs.
Brown & Sharpe Mfg. Co.

Bending and Forming Machines.
Quickwork Co., The.

Bending Machines, Hand and Power.
Buffalo Forge Co.
Cleveland Punch & Shear Works Co.
Hills & Jones Works of the Consolidated Mach. Tool Corp. of America.
Niles-Bement-Pond Co.
Sellers & Co., Inc., Wm.
Underwood Corp., H. B.
Watson-Stillman Co., The.

Bending Machines, Hydraulic.
Chambersburg Engineering Co.
Niles-Bement-Pond Co.
Watson-Stillman Co., The

Bending Rolls — (See Rolls, Bending and Straightening).

Billets, Steel.
Carnegie Steel Co.

Bits, Machine Tool — (See Tool Holder Bits—High Speed Steel).

Bits, Track and Bonding—(See Drills, Track and Bonding).

Blast Gates
American Blower Corp.
Mahr Mfg. Co.

Blocks, Chain — (See Hoists, Chain).

Blooms, Steel.
Carnegie Steel Co.

Blower Fitting Automatic Smoke Box.
Barco Mfg. Co.

Blowers
American Blower Corp.
Buffalo Forge Co.
Mahr Mfg. Co.

Boiler Chemicals.
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Boiler Compounds — (See Compounds, Boiler.)

Boiler Mountings
Lunkenheimer Co.

Boiler, Tube Cleaners—See Tube Cleaners).

Boilers, Locomotive.
American Locomotive Co.
Baldwin Locomotive Works The.
Bradford Corp., The
Commonwealth Steel Co.

Bolt Cutters — (See Thread Cutting Machines, Bolt).

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Bolsters, Steel.
American Steel Foundries.
Bradford Corp., The.
Gould Coupler Co., The.

Bolt Pointers.
National Machinery Co., The

Bolt and Nut Machinery.
Ajax Manufacturing Co.
Landis Machine Co., Inc.
National Mchy. Co., The
Niles-Bement-Pond Co.
Williams Tool Corp.

Bolt and Rod Threaders
National Machinery Co., The.

Bolts & Nuts
Saunders & Sons, Inc., D.

Bonding Outfits, Rail.
Ingersoll-Rand Co.

Books—Railway.
Simmons-Boardman Pub. Co.

Boosters.
Franklin Ry. Supply Co.

Boring Bars.
Davis Boring Tool Co.
Gidding & Lewis Mach. Tool Co.
Ingersoll Milling Machine Co., The.

Boring Bars, Expansion.
Davis Boring Tool Co.

Boring Bars, Loco. Cylinder —(See Boring Machines, Portable).

Boring and Drilling Machines Horizontal.
Betts Works of Consolidated Mach. Tool Corp. of America.
Gidding & Lewis Mach. Tool Co.
Gisholt Machine Co.
Ingersoll Milling Machine Co., The
Lucas Machine Tool Co.
Niles-Bement-Pond Co.
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Boring and Drilling Machines, Vertical.
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Colburn Mach. Tool Works of Consolidated Mach. Tool Corp. of America.
Ingersoll Milling Machine Co., The.
Niles-Bement-Pond Co.
Sellers & Co., Inc., Wm.

Boring and Turning Mills, Vertical.
Betts Works of Consolidated Machine Tool Corp. of America.
Bullard Machine Tool Co.
Colburn Machine Tool Plant of Consolidated Machine Tool Corp. of America.
Niles-Bement-Pond Co.
Sellers & Co., Wm.

Boring Machines, Car Wheel.
Betts Works of Consolidated Mach. Tool Corp. of America.
Ingersoll Milling Machine Co., The.
Niles-Bement-Pond Co.
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Shaw Crane-Putnam Mach. Co., Inc.

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Betts Works of Consolidated Mach. Tool Corp of America.
Newton Works of Consolidated Mach. Tool Corp. of America.
Niles-Bement-Pond Co.
Sellers & Co., Inc., Wm.

Boring Machines, Portable, (for Loco, Cylinder and Valve Chambers).
Morton Mfg. Co.
Rooksby, E. J. & Co.
Underwood Corp., H. B.

Boring Machines, Wood Boring
Ingersoll Milling Mach. Co.
Niles-Bement-Pond Co.
Newton Works of Consolidated Machine Tool Corp of America.

Boring Machines, Locomotive Driving Box.
Sellers & Co., Inc., Wm.

Boring Machines, Tire.
Betts Works of Consolidated Machine Tool Corp. of America.
Niles-Bement-Pond Co.

Boring Machines, Traveling Heads.
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Boring Tools (see Tools, Boring).

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American Steel Founderies.
Bradford Corp., The.
Chicago Ry. Equipment Co.
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Brakes, Electric
Westinghouse Air Brake Co.

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Brakes, Press.
Wine Railway Appliance Co.

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U. S. Graphite Co.
Westinghouse Elec. & Mfg. Co.

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Standard Elextrical Tool Co., The.
U. S. Electrical Tool Co. The.

Buffers, Friction.
Westinghouse Air Brake Co.

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Starrett Co., The. L. S.

Calipers, Micrometer.
Starrett Co., The L. S.

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Chicago Railway Equipment Co.
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General Electric Co.

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General Electric Co.

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American Car & Fdry. Co.

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Cast Steel Welding Rods—(See Welding Rods).

Casting, Elec. Loco.
Commonwealth Steel Co.

Castings, Grey Iron.
American Car & Fdry Co.
Chambersburg Engineering Co.
Gould Coupler Co.

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Commonwealth Steel Co.
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Symington Co., The.

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Symington Co., The.
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International Nickel Co.

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Lunkenheimer Co., The
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Smooth-On Mfg. Co.

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Dearborn Chemical Co.

Chemists.
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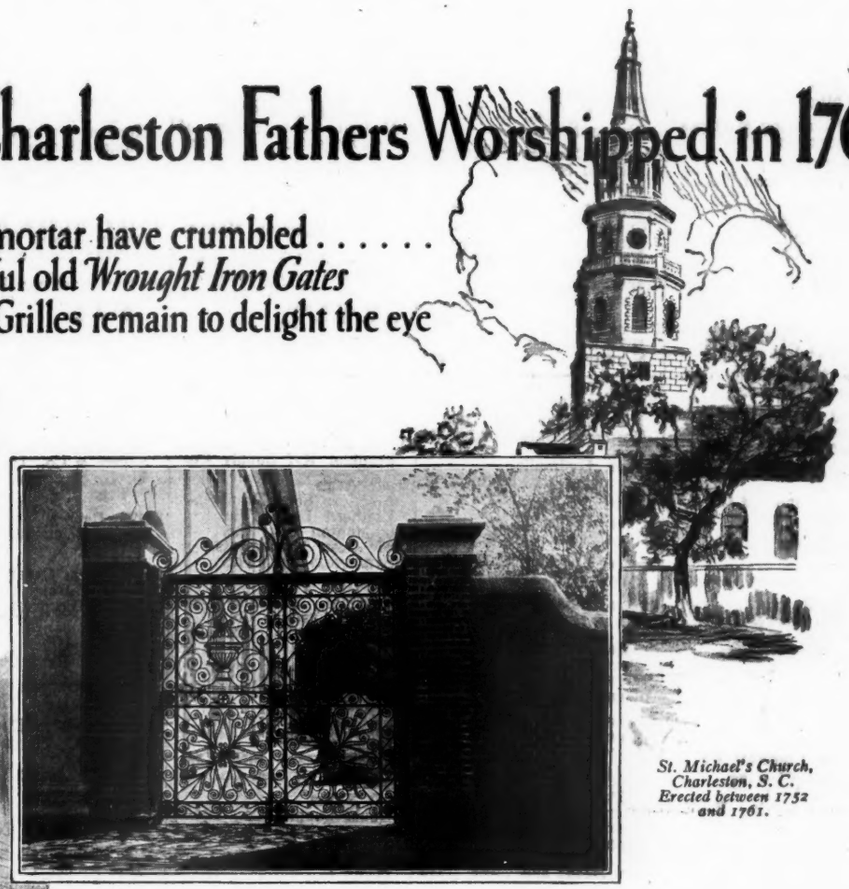
Where the Charleston Fathers Worshipped in 1761

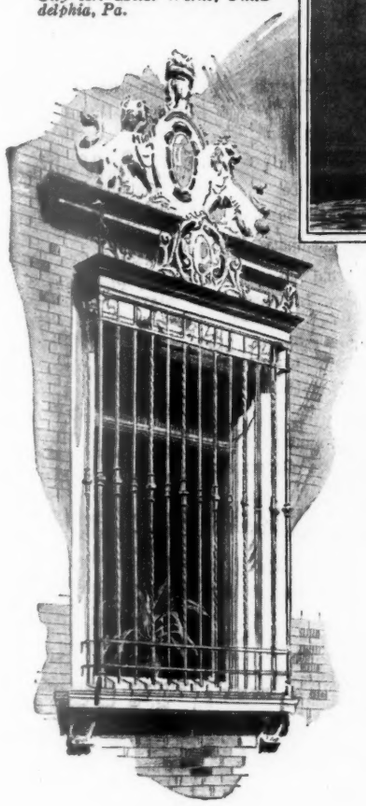
Brick *and* mortar have crumbled . . . . . but beautiful old *Wrought Iron Gates* Fences *and* Grilles remain to delight the eye

(Right) Wrought iron churchyard gates of St. Michael's, in Charleston, S. C. Typical of pre-Revolutionary iron work which has survived to this day. All over the city are wrought iron objects equally prized. The oldest belong to the first half of the eighteenth century.

(Below) The new K. of C. building in Atlantic City is notable for its beautiful grilles, doors, balustrades and other things of wrought iron. Architect Frank A. Berry, Philadelphia, Pa. Ornamental iron work executed by The Quaker City Art Metal Works, Philadelphia, Pa.



St. Michael's Church, Charleston, S. C. Erected between 1752 and 1761.



ST. MICHAEL'S below Broad Street and St. Philip's above—these were the two parishes of the city of Charleston in pre-Revolutionary days. Church going as a social rite in Charleston has always been very much centered in the beautiful churches of these two old congregations. "The bells of St. Michael's are the voice of Charleston."

Wrought iron had a development in Charleston hardly equaled by any other city in America; and the amount of it still to be found there impresses visitors as extraordinary. In richness and appropriateness of design, soundness of workmanship, and durability of material, it excites the reverent wonder of intelligent lovers of the arts.

The original bells of St. Michael's, which had been cast in England, were destroyed during our Civil War and had to be recast. But the old St. Michael's Gates of wrought iron, in characteristic Charleston design and craftsmanship, are in fine preservation to this day. They date from about 1752.

Entirely apart from romantic feeling for things olden, the return to favor of genuine wrought iron during the last decade is remarkable. Where corrosion is a factor, as in pipes for plumbing, heating and other purposes; plates and rivets for tanks, boilers, ships; bars for railings, fire escapes, gratings, hardware and other outdoor purposes, the use of wrought iron is finding increased favor.

Where vibration, shock and repeated stresses call for a metal of the greatest dependability, toughness and immunity to fatigue, wrought iron again stands out as the best material available at economical cost. Hence the extensive use of wrought iron for vital parts of locomotives and railroad cars.

Again, where high welding quality, and suitable surface for retaining paint, enamel, zinc, lead and other finishes is desirable, wrought iron is unexcelled. Discriminating users know that reputable manufacturers of genuine wrought iron bars, plates, pipes and rivets may be depended on to furnish wrought iron of the highest standards of quality ever known.

For information address

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1111 Union Bank Building

Pittsburgh, Pa.

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Ingersoll-Rand Co.

Chucks, Tap.
Union Mfg. Co.

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Niles-Bement-Pond Co.

Clamps, Hose.
Ingersoll-Rand Co.
National Malleable & Steel Castings Co.

Clamps, Machinists'.
Starrett Co., The L. S.

Clamps, Pipe.
National Malleable & Steel Castings Co.

Cleaner, Metal—(See Compounds, Cleaning).

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Houghton & Co., E. F.
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Condensers.
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Franklin Ry Supply Co.
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Ingersoll-Rand Co.
Morton Mfg. Co.
Westinghouse Air Brake Co.

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Dart Mfg. Co., E. M.
Walworth Co.

Couplings, Pipe.
Dart Mfg. Co., E. M.
Walworth Co.

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Baker-Raulang Co.

Cranes, Electric Traveling.
Chisholm-Moore Mfg. Co.
Niles-Bement-Pond Co.
Northern Engineering Wks.

Cranes, Foundry.
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Cranes, Gantry.
Niles-Bement-Pond Co.
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Cranes, Hand Power.
Chisholm-Moore Mfg. Co.
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Northern Engineering Wks

Cranes, Hydraulic.
Chambersburg Engineering Co.

Cranes, Industrial.
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Poor, Inc., Fred'k H.

Cranes, Portable Electric.
Elwell-Parker Electric Co.

Cranes, Tractor Mounted.
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Underwood Corp., H. B.

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Cutters, Gear.
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Draft Gears
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Ingersoll Milling Machine Co., The.

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U. S. Electric Tool Co., The.

Drilling Machines, Portable, Pneumatic.
Cleveland Pneumatic Tool Co.
Ingersoll-Rand Co.

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Sellers & Co., Inc., Wm.

Drilling Machines, Radial.
Buffalo Forge Co.
Gidding & Lewis Mach. Tool Co.

Drilling Machines, Rail.
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Ingersoll Milling Machine Co., The.
Newton Works of Consolidated Machine Tool Corp. of America.
Niles-Bement-Pond Co.
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Ingersoll-Rand Co.
Sullivan Machinery Co.

Drilling Machines, Universal.
Gidding & Lewis Mach. Tool Co.

Drilling Machines, Vertical.
Buffalo Forge Co.
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Drills, Close Corner.
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Drills, Core.
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Expanders, Sectional Beading.
Faessler Mfg. Co., J.

Expanders, Tube.
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Fans, Electric.
American Blower Corp.
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General Electric Co.
Westinghouse Elec. & Mfg. Co.

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Superheater Co., The.
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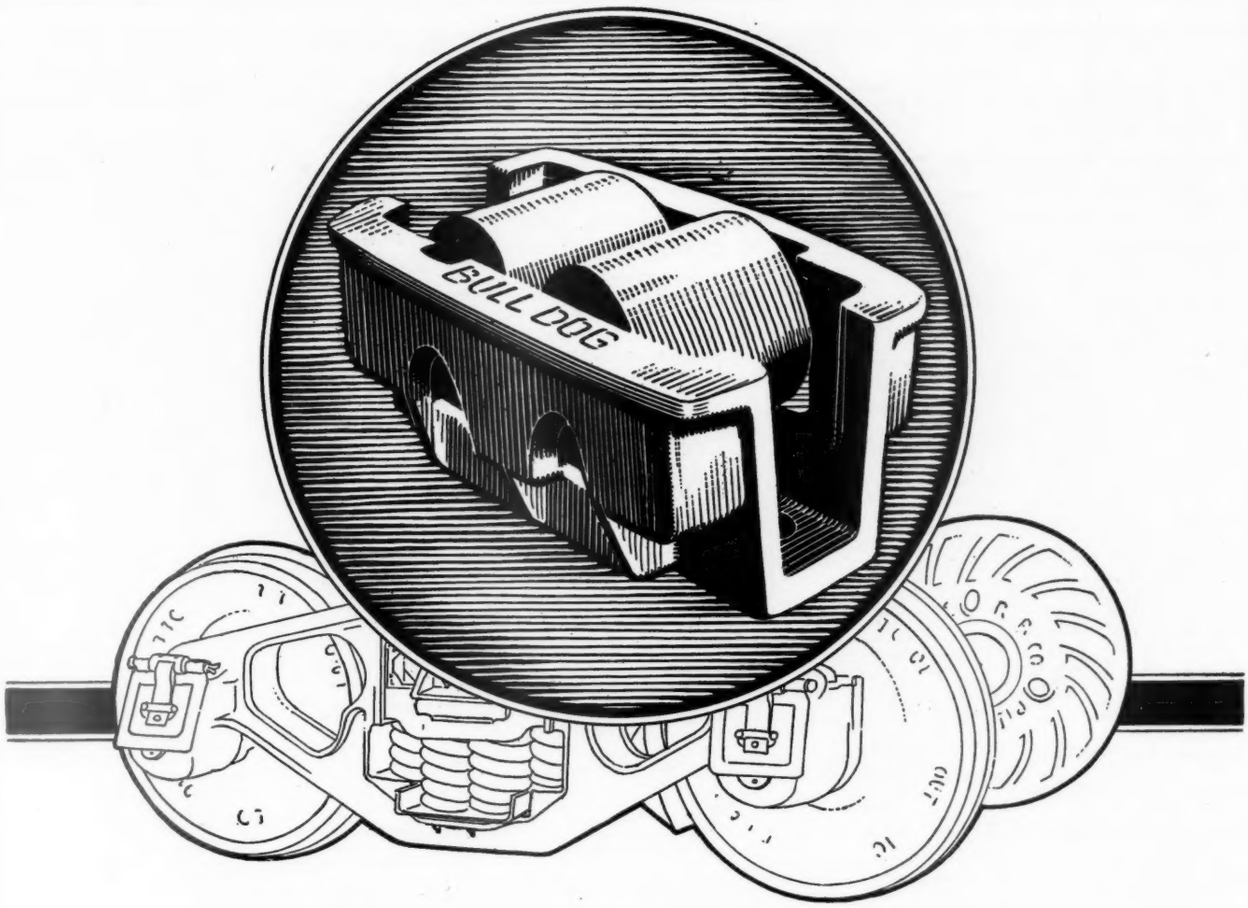

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Thompson Grinder Co., The.

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Geometric Tool Co., The.
Modern Tool Works of Consolidated Machine Tool Corp. of America.
National Machinery Co.
Thompson Grinder Co., The.

Grinding Machines, Drill.
Sellers & Co., Inc., Wm.

Grinding Machines, Edge.
Thompson Grinder Co., The.

Grinding Machines, Electric.
Standard Electrical Tool Co.
U. S. Electrical Tool Co., The.

Grinding Machines, Floor Type.
Landis Tool Co.
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U. S. Electrical Tool Co., The.

Grinding Machines, Gap.
Landis Tool Co.

Grinding Machines, Internal.
Heald Machine Co.
Landis Tool Co.
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Grinding Machines, Surface.
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Thompson Grinder Co., The.
U. S. Electric Tool Co., The.

Grinding Machines, Surface Rotary Table.
Heald Machine Co.

Grinding Machines, Tool.
Brown & Sharpe Mfg. Co.

Grinding Machines, Universal.
Brown & Sharpe Mfg. Co.
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Thompson Grinder Co., The.

Grinding Machines, Universal Tool.
Landis Tool Co.
Sellers & Co., Inc., Wm.
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Standard Electrical Tool Co.

Ground Rods.
Page Steel & Wire Co.

Guards, Dust.
Gould Coupler Co., The.
Symington Co., The.

Guards, Machine.
Page Steel & Wire Co.

Hack Saw Machines, Power—(See Sawing Machines, Power Hack).

Hack Saws — (See Saws, Hack).

Hammers, Air.
Ingersoll-Rand Co.
Nazel Engineering & Machine Works.

Hammers, Belt and Motor Driven.
Chambersburg Engineering Co.
Nazel Engineering & Machine Works.

Hammers, Board Drop.
Chambersburg Engineering Co.

Hammers, Drop.
Chambersburg Engineering Co.
Niles-Bement-Pond Co.
United Eng. & Fdry. Co.

Hammers, Forging.
Chambersburg Engineering Co.

Hammers, Pneumatic.
Cleveland Pneumatic Tool Co.
Ingersoll-Rand Co.

Hammers, Pneumatic Forging.
Chambersburg Engineering Co.
Nazel Engineering & Machine Works.
Niles-Bement-Pond Co.
Sullivan Machinery Co.

Hammers, Power.
Nazel Engineering & Machine Works.

Hammers, Power, Belt and Motor Driven.
Quickwork Co., The.

Hammers, Riveting
Ingersoll Rand Co.

Hammers, Sheet Metal.
Quickwork Co., The.

Hammers, Steam.
Sellers & Co., Inc., Wm.

Hammers, Steam Forging.
Niles-Bement-Pond Co.

Hammers, Steam and Steam Drop.
Chambersburg Engineering Co.

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Starrett Co., The L. S.

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Hangers, Shaft.
Brown & Sharpe Mfg. Co.
Sellers & Co., Inc., Wm.

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General Electric Co.

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Heating Systems, Car (Electric).
Wine Railway Appliance Co.

Heating & Ventilating Equipment.

Heaters, Ladle.
Mahr Mfg. Co.

High Speed Steel — (See Steel, High Speed).

Hobs.
Brown & Sharpe Mfg. Co.
National Tool Co., The

Hobbing Machines, Gear, Spur and Spiral.
Brown & Sharpe Mfg. Co.

Hoists, Air.
Hanna Engineering Works
Ingersoll-Rand Co.

Hoists, Chain.
Chisholm-Moore Mfg. Co.
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Hoists, Electric.
Chisholm-Moore Mfg. Co.
General Electric Co.
Niles-Bement-Pond Co.
Northern Engineering Wks.
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Hoists, Hand.
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Niles-Bement-Pond Co.
Union Mfg. Co.

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Hoists, Portable.
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Westinghouse Air Brake Co.

Hose, Air Brake.
Westinghouse Air Brake Co.

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Ingersoll-Rand Co.

Hose Couplings—(See Couplings, Hose).

Hose, Flexible Metallic.
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Franklin Ry. Supply Co.

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Sellers & Co., Inc., Wm.

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Sellers & Co., Inc., Wm.
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Injectors, Feedwater Heater Exhaust Steam.
Sellers & Co., Inc., Wm.

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Sellers & Co., Inc., Wm.

Injectors, Stationary.
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Quickwork Co., The

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Franklin Ry. Supply Co.

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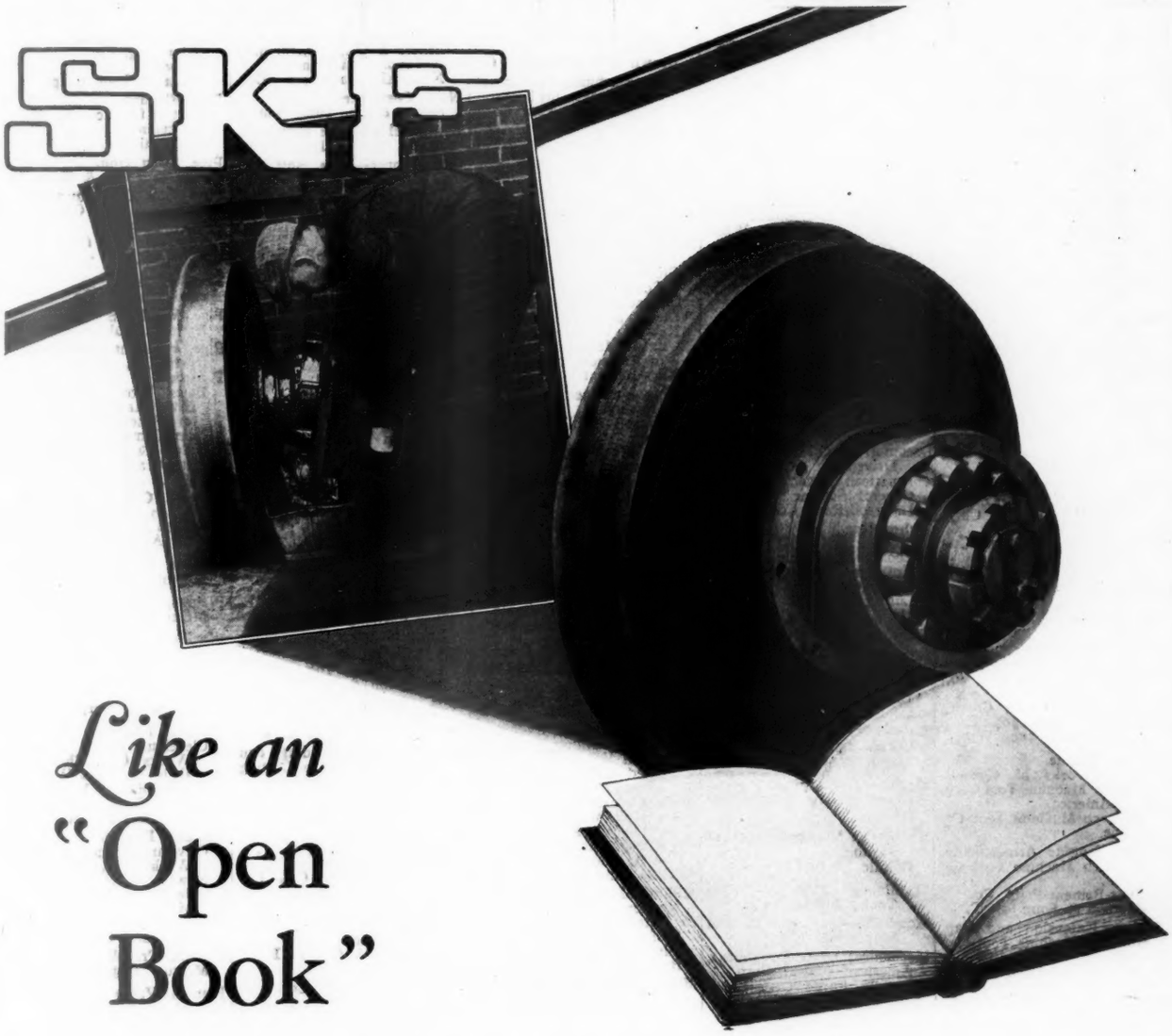

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Monarch Machine Teol Co. The.
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American Locomotive Co. The
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Ingersoll Milling Mach Co.
Newton Machine Tool Works of the Consolidated Machine Tool Corp. of America.

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Milling Machines, Radius.
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Milling Machines, Slab.
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Milling Machines, Tread
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Nut Tapping Machines
National Machinery Co.,

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Packing, Air Brake.
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Packing, Cup Flange.
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Packing, Hydraulic, Oil, Pneumatic.
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Packing, Metallic.
Garlock Packing Co.

Packing, Sheet.
Garlock Packing Co., The

Packing Soft
Garlock Packing Co., The

Packing, Valve Stem.
Garlock Packing Co., The

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Dixon Crucible Co., Jos.
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Lehon Co., The.

Paper, Sheathing.
Lehon Co., The.

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Page Steel & Wire Co.

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Carnegie Steel Co.

Pilot Beams, Cast Steel.
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Pins, Coupler Knuckle.
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Hilles & Jones Works of Consolidated Machine Tool Corp. of America.
Sellers & Co., Inc., Wm.

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Cleveland Punch & Shear Works Co., The
Newton Works of Consolidated Machine Tool Corp. of America.
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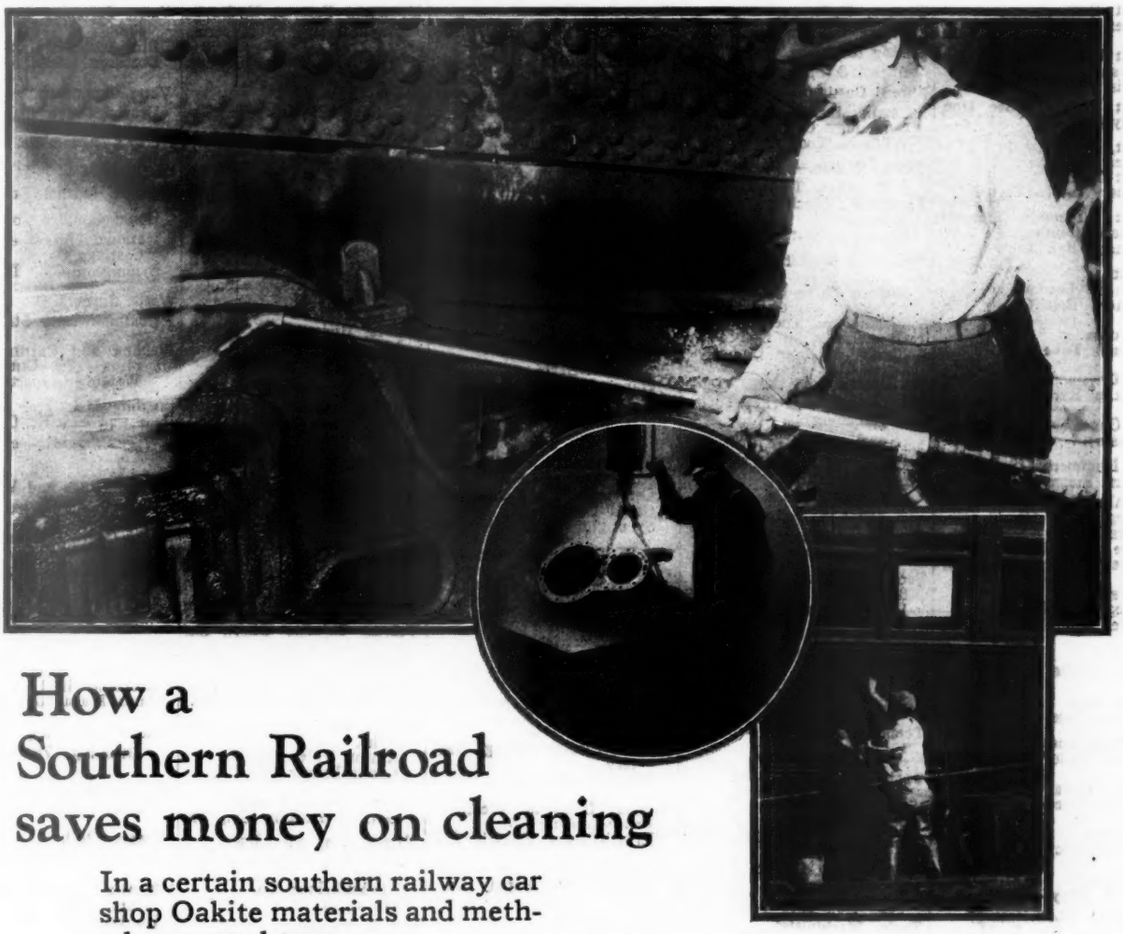

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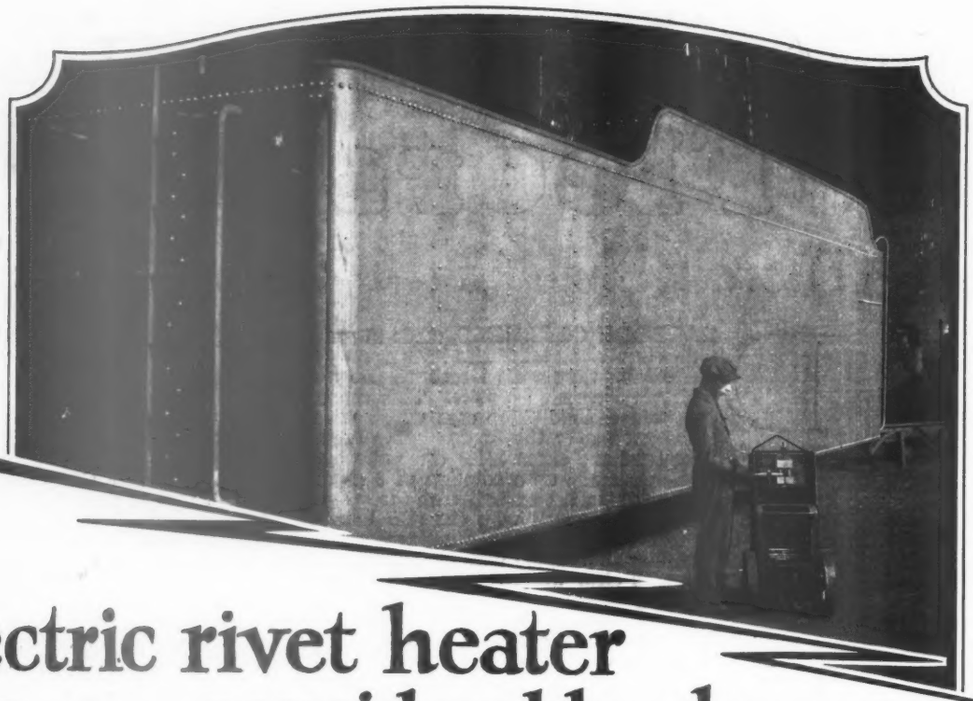

In the a.c.f. Berwick Electric Rivet Heater the rivet is heated from center outward.

"electric rivet heater considerably cheaper"

—American Locomotive Company

The American Locomotive Company uses 51 a.c.f. BERWICK Electric Rivet Heaters, two of which are shown in the picture.

"Exhaustive tests demonstrated that the Electric Rivet Heater is considerably cheaper," writes the American Locomotive Company. "We can start the riveting gangs much quicker" . . . "considerable saving has been accomplished by the elimination of burned rivets" . . . "and the Electric Heaters have increased our output."

But that is not all. Visible electric heating of rivets is *better* as well as *cheaper* than ordinary forge heating. Better because it makes it easy to maintain a uniform rivet temperature, which means fewer hammer blows and tighter riveting. There is also less scale with electric heating, and this, too, helps to improve the quality of the riveting.

Other features: One rivet or thousands, without waste. Hot rivets on a few seconds' notice; no waiting; no loss of time. No compressed air is needed. Simple, easy to operate, safe; less fire risk. No handling of fuel or ashes, no delays due to sluggish fuel in cold weather, no furnace relining or other forge upkeep expenses.

Investigate ELECTRIC heating of rivets. Printed matter, and names of users in your line of work, will be mailed on request.

AMERICAN CAR AND FOUNDRY COMPANY

30 CHURCH STREET, NEW YORK

a.c.f.

BERWICK

ELECTRIC RIVET HEATER

a.C.f.

IN THE SERVICE OF THE NATION'S RAILWAYS, HIGHWAYS, WATERWAYS, INDUSTRIES